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

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| **PART A** |

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| 1. Course No/Course Code | **EEE 3102** |
| 1. Course Title | **Digital Logic and Circuits Lab** |
| 1. Course Type | Core Course |
| 1. Year/Level/Semester/Term | Second year (5th Semester) |
| 1. Academic Session | Fall 2023-24 |
| 1. Course Teachers/Instructors | Dr. Tanbir Ibne Anowar, Dr. Muhammad Morshed Alam, Dr. Md Humayun Kabir, Nuzat Nuary Alam, Mr. Shahriyar Masud Rizvi, Mr. Ali Noor, Mr. Tamim Hossain, Md. Shahariar Parvez, Richard Victor Biswas, Md. Ashiquzzaman, Abrar Liaf, Md. Alomgir Kabir, Mr. Mehedi Hasan |
| 1. Pre-requisite (If any) | **EEE 2103: Electronic Device** |
| 1. Credit Value | 1 credit hour |
| 1. Contact Hours | 4 hours of lab per week |
| 1. Total Marks | 100 |
| 1. 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. |
| 1. 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. |
| 1. Rationale of the Course (Course Description) | This is a core course of Electrical and Electronic Engineering program that presents basic tools for the design of digital circuits. It serves as a building block in many disciplines that utilize data of digital nature like digital control, data communication, digital computers etc. |
| 1. Course Content | The course is designed to provide students with:   * Perform arithmetic operations in many number systems, Manipulate Boolean algebraic structures, Implement the Boolean Functions using NAND and NOR gates, Simplify the Boolean expressions using Karnaugh Map. * Analyze and design various combinational logic circuits, Study of Storage Elements: Introduction to the behavior and structure of latches, flip-flops, and registers, Understand the importance of state diagram representation of sequential circuits, Study Sequential Circuits: Analyze and design clocked sequential circuits, Perform Timing Analysis: * Introduction to timing analysis of combinational and sequential circuits. Special characteristics of Digital logic families and their comparative discussion. Definition and Problem solving on Fan out, Noise Margin, Propagation Delay, Power Dissipation, Duty Cycle and Speed Power Product. Diode Logic Gates. * Basic Diode Transistor Logic Gates: RTL, DTL, Modified DTL and HTL with operational detail. MOS and CMOS Logic with operational detail. Basic memory units and operations. |

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| **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** | **Details** | **K** | **P** | **A** | **Assessed Program Outcome Indicator** | **BNQF Indicator** | **Assessment Techniques** |
| CO1 | Apply proper information and concepts of different logic gates, digital ICs, transistors, and timers to implement logical circuits. | K3 | P1,  P2,  P6 |  | P.a.3.C3 | FS.1 | Mid and Final lab quizzes |
| **CO2** | **Analyze a**  **combinational/sequential logic circuit through appropriate survey of research literature to provide valid conclusion acknowledging the limitations.** | **K8** |  |  | **P.d.2.C4** | **FS.6** | **OEL Report (final)** |
| CO3 | Apply concepts of digital logic design and logic gates to design, implement, simulate, and demonstrate different types of digital electronic circuits using various hardware and software tools. |  | P1,  P4,  P5 |  | P.e.2.P4 | FS.6 | Mid lab reports,  Final lab reports, Project Report and Project Proposal |
| CO4 | Make and deliver an effective presentation on a digital logic gate-based project based on the problem for complex engineering activities. |  |  | A1,  A2 | P.j.3.A4 | SS.2 | Project Presentation/Demonstration |
| CO5 | Use any simulation and/or hardware tool for the prediction of electronic circuit behavior under various conditions and constraints as if the problems are complex in nature. |  | P1, P4, P5 |  | P.e.2.P4 | FS.6 | Performance Test |

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| **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.1 |  |  |  |  |  |  |  |  |  |  |  |
| **2** |  |  |  | FS.6 |  |  |  |  |  |  |  |  |
| **3** |  |  |  |  | FS.6 |  |  |  |  |  |  |  |
| **4** |  |  |  |  |  |  |  |  |  | SS.2 |  |  |
| **5** |  |  |  |  | FS.6 |  |  |  |  |  |  |  |

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| **PART B** |

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| **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** | **Evidence** |
| **Week 1** | Mission & Vision of AIUB, Dept. of EEE, introduction of equipment and tools to be used and objectives of this course.  Familiarization with course outline and in- detail of course outcomes, CO.  **Exp.1:** Studying different digital logic gates and designing of basic logic gates using Universal gates. | **Brief theoretical description, Teaching circuit implementation and use of different tools,**  **Computer simulation and hardware implementation.** | Practical implementation & Software simulation of each lab work. | CO1  CO3 | LAB Quiz,  Lab Report, |
| **Week 2** | **Exp.2:** Derive logic equations and truth table from a given statement and construction of combinational circuits. | CO1  CO3 | LAB Quiz,  Lab Report, |
| **Week 3** | **Exp. 3:** Design of adder, subtractor and comparator circuits | CO1  CO3 | LAB Quiz,  Lab Report, |
| **Week 4** | **Exp. 4:** Designing Multiplexer (MUX) and Demultiplexer (DEMUX), Encoder and Decoder Circuits |  | CO1  CO3 | LAB Quiz,  Lab Report, |
| **Week 5** | **Exp. 5:** Construction of different Logic Gates using various types of semiconductor devices. |  | CO1  CO3 | LAB Quiz,  Lab Report, |
| **Week 6** | **Performance test, & Midterm Quiz, Submission of Project proposal** |  | CO1  CO3  CO5 | Performance test report, Project Proposal, Quiz |
| **Week 7** | **MID-TERM Theory EXAM WEEK** | | | | |
| **Week 8** | Exp. 6: Study of Different Flip-Flops. | **Brief theoretical description, Teaching circuit implementation and use of different tools,**  **Computer simulation and hardware implementation.** | Practical implementation & Software simulation of each lab work. | CO1  CO3 | LAB Quiz,  Lab Report |
| **Week 9** | Exp. 7: Implementation of Asynchronous and synchronous counters using flip-flops | CO1  CO3 | LAB Quiz,  Lab Report |
| **Week 10** | Exp. 8: Construction Logic Gates using various MOS transistors | CO1  CO3 | LAB Quiz,  Lab Report |
| **Week 11** | Exp. 9: Design and implementation of multivibrators using Timer IC | CO1  CO3 | LAB Quiz,  Lab Report |
| **Week 12** | Exp. 10: Design of a Digital to Analog and Analog to Digital Converters. | CO1  CO3 | LAB Quiz,  Lab Report |
| **Week 13** | Open-ended lab | CO2 | OEL Report |
| **Week 14** | Presentation of Project including Hardware Demonstration, Project report submission, and Final Lab Quiz, and Final term lab quiz |  | CO1  CO3  CO4 | Project presentation and report, Quiz |
| **Week 15** | **FINAL-TERM Theory EXAM WEEK** | | | | |

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

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| **PART C** |

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| **18. Assessment and Evaluation** |

1. **Assessment Strategy:**

**COs/CLOs Assessment Tools for Mid-Term**

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| **Assessment Tools** | **CO/CLO 1 Marks** | **CO/CLO 2 Marks** | **CO/CLO 3 Marks** | **CO/CLO 4 Marks** | **CO/CLO 5 Marks** | **Marks for Grading** |
| Attendance |  |  |  |  |  | 10 |
| Lab Report |  |  | 30 |  |  | 30 |
| Performance Test (Individual) |  |  |  |  | 20 | 20 |
| Project Proposal |  |  | 20 |  |  | 20 |
| Midterm Lab Quiz | 20 |  |  |  |  | 20 |
| **Total** |  |  |  |  |  | **100** |

**COs/CLOs Assessment System for Final-Term**

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| --- | --- | --- | --- | --- | --- |
| **Assessment Tools** | **CO/CLO 1 Marks** | **CO/CLO 2 Marks** | **CO/CLO 3 Marks** | **CO/CLO 4 Marks** | **Marks for Grading** |
| Attendance |  |  |  |  | 10 |
| Lab Report |  |  | 20 |  | 20 |
| **Open-Ended Lab Report (OBE)** |  | **20** |  |  | **20** |
| Project Presentation and Demonstration |  |  |  | 20 | 20 |
| Final Lab Quiz | 20 |  |  |  | 20 |
| Project Report |  |  | 10 |  | 10 |
| **Total** |  |  |  |  | **100** |

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 to Exp 5 | CO1 | 2 | 5 | 1 |  |  |  |  |  |  | 5 | PS | 20 |  |  |  |  |  |  |  |  |  | P.a.3.C3 |
| **Total** |  | **5** | **4** |  |  |  |  |  |  |  |  |  | **20** |  |  |  |  |  |  |  |  |  |  |

**Final 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 to Exp 9 | CO1 | 2 | 5 | 1 |  |  |  |  |  |  | 5 | PS | 20 |  |  |  |  |  |  |  |  |  | P.a.1.C3 |
| **Total** |  | **5** | **4** |  |  |  |  |  |  |  |  |  | **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:***

1. **Marks Distribution:**

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| --- | --- | --- |
| **Assessment Type** | **Marking system For Final term** | |
| Continuous | Attendance | 10% |
| Continuous | Lab Report | 20% |
| Continuous | OEL Report (Lab report) | 20% |
| Summative | Project Presentation and Demonstration | 20% |
| Summative | Project Report (IEEE format) | 10% |
| Summative | Final Lab Quiz | 20% |
|  | **Total** | 100% |

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 For Midterm** | |
| Continuous | Attendance | 10% |
| Continuous | Lab Report | 30% |
| Continuous | Individual Performance test and Report | 20% |
| Summative | Project Proposal | 20% |
| Summative | Midterm Lab Quiz | 20% |
|  | **Total** | 100% |

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|  | **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.

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| **PART D** |

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| **19. Learning Materials** |

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.

1. **Recommended Readings (Textbook);**

[1] Thomas L. Floyd, “Digital Fundamentals” 9th edition, Prentice Hall.

[2] M. Morris Mano, “Digital Logic & Computer Design” Prentice Hall.

[3] Richard C. Jaeger & Travis N. Blalock, “Microelectronic Circuit Design” – 4th Edition

1. **Supplementary Readings (Reference Book);**

[1] Mike W. Martin, Roland Schinzinger, “Introduction to engineering ethics” 2nd ed, McGraw-Hill.

[1] Ronald J. Tocci & Neal S. Widmer, “Digital Systems” 7th edition, Prentice Hall.

[2] Digital design – Karim and Johnson

[3] Brian Holdsworth and Clive Woods, “Digital Logic Design”-Fourth Edition.

[4] Stephen Brown and ZvonkoVranesic, “Fundamentals of Digital Logic with VHDL Design with CD-

ROM”

[5] William J. Dally and R. Curtis Harting, “Digital Design: A Systems Approach”

[6] Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and David Irwin, “Digital Logic Circuit Analysis and

Design”

[7] John P. Hayes, “Introduction to Digital Logic Design”

[8] Norman Balabanian and Bradley Carlson, “Digital Logic Design Principles”

[9] Enoch O. Hwang, “Digital Logic and Microprocessor Design with VHDL”

[10] Joseph Cavanagh, “Digital Computer Arithmetic: Design and Implementation (Computer Science)”

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| **PART E** |

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| Verification:  **EEE 3102: Digital Logic and Circuits Lab** | | |
| Prepared by:  ………………………………...  Mr. Mehedi Hasan  (Course Co-ordinator)  Date: 13/10/2023 | 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: …………………………. |

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| **Appendix A** |

**Table 1: Knowledge Profile** (according to BAETE Manual 2nd Edition)

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| Attribute | |
| **K1** | A systematic, theory-based understanding of the natural sciences applicable to the discipline |
| **K2** | Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline |
| **K3** | A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline |
| **K4** | Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline |
| **K5** | Knowledge that supports engineering design in a practice area |
| **K6** | Knowledge of engineering practice (technology) in the practice areas in the engineering discipline |
| **K7** | Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer’s professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability |
| **K8** | Engagement with selected knowledge in the research literature of the discipline |

**Table 2: Range of Complex Engineering Problem Solving** (according to BAETE Manual 2nd Edition)

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| **Attribute** | **Complex Engineering Problems** have characteristic P1 and some or all of P2 to P7: |
| Depth of knowledge required | P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach |
| Range of conflicting requirements | P2: Involve wide-ranging or conflicting technical, engineering and other issues |
| Depth of analysis required | P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models |
| Familiarity of issues | P4: Involve infrequently encountered issues |
| Extent of applicable codes | P5: Are outside problems encompassed by standards and codes of practice for professional engineering |
| Extent of stakeholder  involvement and conflicting requirements | P6: Involve diverse groups of stakeholders with widely varying  Needs |
| Interdependence | P7: Are high level problems including many component parts or sub-problems |

**Table 3: Range of Complex Engineering Activities** (according to BAETE Manual 2nd Edition)

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| **Attribute** | **Complex activities** means (engineering) activities or projects  that have some or all of the following characteristics: |
| Range of resources | A1: Involve the use of diverse resources (and for this purpose  resources include people, money, equipment, materials,  information and technologies) |
| Level of interaction | A2: Require resolution of significant problems arising from  interactions between wide-ranging or conflicting technical,  engineering or other issues |
| Innovation | A3: Involve creative use of engineering principles and research based knowledge in novel ways |
| Consequences for society  and the environment | A4: Have significant consequences in a range of contexts,  characterized by difficulty of prediction and mitigation |
| Familiarity | A5: Can extend beyond previous experiences by applying  principles-based approaches |

### **Table 4: Learning Outcome Domains and Level Descriptors (as per BNQF)**

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| **Learning Outcome Domains** |
| **Fundamental Skills (FS):**  FS.1: demonstrate knowledge and critical understanding of the well-established principles of his/her field of study, and of the way in which those principles have developed;  FS.2: apply underlying concepts and principles outside the context in which they were first studied, including, where appropriate, the application of those principles in an employment context;  FS.3: apply knowledge and skills in addressing issues/solving problems with minimal supervision;  FS.4: evaluate critically the appropriateness of different approaches to solving problems in his/her field of study;  FS.5: support supervision of junior staff via a mentor or a leader/manager; and  FS6: display advanced digital literacy which is adequate to perform complex tasks and bring about solutions. |
| **Social Skills (SS):**  SS.1: communicate and interact effectively and clearly, ideas, information, problems and solutions as a team to peers, experts and non-experts in Bangla and English;  SS.2: express her/himself fluently and spontaneously in English and Bangla;  SS.3: use language flexibly and effectively for social, academic and professional purposes;  SS.4: produce clear, well structured, detailed text on complex subjects, showing controlled use of organisational patterns, connectors and cohesive devices in advanced proficiency level of Bangla and English;  SS.5: demonstrate the ability to incorporate entrepreneurial skills in planning daily activities; and  SS.6: display advanced civic literacy and knowledge, exercising civic rights and obligations at all levels as well as participating in changes for the improvement of Bangladesh society. |
| **Thinking Skills (TS):**  TS.1: exercise very substantial degree of autonomy and often significant responsibility in making judgments/ decisions towards the management of self, others and for the allocation of substantial resources; and  TS.2: demonstrate professional knowledge and practical skills in both technical and management to lead a team in inexperienced environment. |
| **Personal Skills (PS):**  PS.1: engage in self-direction and self-enterprise skills;  PS.2: demonstrate social, professional, environmental and ethical practice/ values;  PS.3: show-case global knowledge and competencies to fulfil employment, entrepreneurial and lifelong learning skills; and  PS.4: contribute significantly to the society. |

Detail Program Outcomes

## **PO-a/PLO 1: Engineering Knowledge**

Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.

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| **Indicators ID** | **BNQF Indicator** | **Indicators Definition** | **Domain** | **W** | **Course 1** | **Course 2** | **K** | **P** | **A** | **Assessment Technique(s)** |
| **P.a.1.C3** | N/A | Apply information and concepts in *natural science* with the familiarity of issues. | Cognitive Level 3 (Applying) | 0.1 | EEE1203: Electrical Circuits – 1 (DC) | EEE3213: Electrical Properties of Material | K1 |  |  | Assignment |
| **P.a.2.C3** | N/A | Apply information and concepts of *mathematics* with the familiarity of issues. | Cognitive Level 3 (Applying) | 0.1 | EEE2209: Analog Electronics | EEE2213: Signals and Linear Systems | K2 |  |  | Assignment |
| **P.a.3.C3** | **FS.1** | Apply information and concepts in *engineering fundamentals* to solve complex engineering problems with a range of conflicting requirements. | Cognitive Level 3 (Applying) | 0.4 | EEE2105: Electrical Machines 1 | EEE3101: Digital Logic and Circuits | K3 | P1, P2, P6 |  | Assignment |
| **P.a.4.C3** | N/A | Apply information and concepts in *specialized engineering sciences* with the in-depth of analysis of a complex engineering problem. | Cognitive Level 3 (Applying) | 0.4 | EEE3105: Industrial Electronics and Drives | EEE4101: Modern Control Systems | K4 | P1, P3, P7 |  | Assignment |

## **PO-b/PLO 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. (K1 to K4).

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| **Indicators ID** | **BNQF Indicator** | **Indicators Definition** | **Domain** | **W** | **Course 1** | **Course 2** | **K** | **P** | **A** | **Assessment Technique(s)** |
| **P.b.1.C4** | N/A | Identify first principles of natural sciences and engineering sciences in practical applications. | Cognitive Level 4  (Analyze) | 0.1 | EEE2101: Electrical Circuits 2 (AC) | EEE2103: Electronic Devices | K1 |  |  | Assignment |
| **P.b.2.C4** | N/A | Formulate solutions, procedures, and methods using first principles of mathematics for engineering sciences. | Cognitive Level 4 (Analyzing) | 0.1 | EEE3101: Digital Signal Processing | EEE3107: Electromagnetics Fields and Waves | K2 |  |  | Assignment |
| **P.b.3.C4** | FS.3 | Analyze solutions for complex engineering problem reaching substantiated conclusion. | Cognitive Level 4 (Analyze) | 0.4 | EEE3211: Power Systems Analysis | EEE2207: Electrical Machines 2 | K3 | P1, P3, P7 |  | Assignment |
| **P.b.4.C4** | N/A | Research literature and analyze the validity and accuracy of existing solution for complex engineering problems. | Cognitive Level 4 (Analysis) | 0.4 | EEE2208: Electrical Machines 2 Lab | EEE4209: Telecommunications Engineering | K4 | P1, P2, P6 |  | Case Study |

## **PO-c/ PLO 3: Design/ development of solutions**

Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5).

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| **Indicators ID** | **BNQF Indicator** | **Indicators Definition** | **Domain** | **W** | **Course 1** | **Course 2** | **K** | **P** | **A** | **Assessment Technique(s)** |
| **P.c.1.C4** | N/A | Design solutions for components of an engineering problem considering public health and safety. | Cognitive Level 4 (Analyzing) | 0.2 | BAE1201: Basic Mechanical Engineering | EEE2211: Electrical Power Transmission & Distribution | K5 |  |  | Assignment |
| **P.c.2.C6** | N/A | Develop process for complex engineering problems considering cultural and societal factors. | Cognitive Level 6 (Create) | 0.4 | EEE4000: Capstone Project | EEE2102: Electrical Circuits 2 (AC) Lab | K5 | P1, P3, P7 |  | Report |
| **P.c.3.C5** | N/A | Evaluate solutions that meet specified needs with appropriate environmental considerations. | Cognitive Level 5 (Evaluate) | 0.4 | EEE4211: Measurement and Instrumentation | EEE4213: Power Stations and Substations | K5 | P1, P2, P6 |  | Assignment |

## **PO-d/ PLO 4: Investigation**

Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

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| **Indicators ID** | **BNQF Indicator** | **Indicators Definition** | **Domain** | **W** | **Course 1** | **Course 2** | **K** | **P** | **A** | **Assessment Technique(s)** |
| **P.d.1.C5** | N/A | Investigate the design of experiments for complex engineering problem through appropriate research. | Cognitive Level 5 (Evaluating) | 0.4 | EEE4103: Microprocessor and Embedded System | EEE3215: Principles of Communication Lab | K8 | P1, P3, P7 |  | OEL lab/Project/Assignment |
| **P.d.2.C4** | N/A | Analysis and Interpretation of collected data to provide valid conclusion acknowledging the limitations. | Cognitive Level 4 (Analyzing) | 0.2 | EEE2104: Electronic Devices Lab | EEE3102: Digital Logic and Circuits Lab | K8 |  |  | OEL |
| **P.d.3.C5** | FS.2 | Investigate solution of complex engineering problem by synthesis of information to provide valid conclusions. | Cognitive Level 5 (Evaluating) | 0.4 | EEE2106: Electrical Machines 1 Lab | EEE4102: Modern Control Systems Lab | K8 | P1, P4, P5 |  | Project/OEL |

## **PO-e/PLO 5: Modern Tool Usage**

Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6).

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| **P.e.1.C6** | N/A | Select engineering tools and Apply appropriate techniques to solve complex engineering problems considering the limitations. | Cognitive Level 6  (Create) | 0.4 | BAE2101: Computer Aided Design and Drafting | EEE2210: Analog Electronics Lab | K6 | P1, P4, P5 |  | OEL/project |
| **P.e.2.P4** | N/A | Use tools for prediction and modeling of complex engineering problems considering the practice in electrical and electronic engineering discipline. | Psychomotor Level 4  (Articulation) | 0.3 | EEE4217: VLSI Circuit Design Lab | EEE4208: Electrical Services Design Lab |  | P1, P4, P5 |  | OEL/project |
| **P.e.3.P5** | FS.6 | Create relevant resources for complex engineering problems using modern engineering tools. | Psychomotor Level 5  (Naturalization) | 0.3 | EEE3101: Digital Signal Processing | EEE4217: VLSI Circuit Design Lab |  | P1, P3, P7 |  | OEL/project |

## **PO-f/ PLO 6: The Engineer and Society**

Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)

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| **P.f.1.A3** | PS.4 | Accepts and Recognize the role of  engineering in society, health, safety, legal and culture. | Affective Level 3  (Valuing) | 0.3 | EEE4208: Electrical Services Design Lab | BAE1201: Basic Mechanical Engineering |  |  |  | Project/Assignment |
| **P.f.2.C6** | FS.4 | Design solution for complex engineering problem in accordance with professional practices | Cognitive Level 6 (Create) | 0.7 | EEE2215: Engineering Ethics and Environmental Protection | EEE4000: Capstone Project | K7 | P1, P3, P7 |  | Assignment/Report |

## **PO-g/PLO 7: Environment and Sustainability**

Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)

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| **Indicators ID** | **BNQF Indicator** | **Indicators Definition** | **Domain** | **W** | **Course 1** | **Course 2** | **K** | **P** | **A** | **Assessment Technique(s)** |
| **P.g.1.C5** | N/A | Evaluate sustainability of complex engineering problems considering society and environment. | Cognitive Level 5  (Evaluating) | 1.0 | EEE4213: Power Stations and Substations | EEE4000: Capstone Project | K7 | P1, P2, P6 |  | Report |

## **PO-h/ PLO 8: Ethics**

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)

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| **P.h.1.C3** | PS.2 | Apply professional codes of ethics and standards considering public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability. | Cognitive Level 3 (Applying) | 0.3 | EEE2215: Engineering Ethics and Environmental Protection | EEE4000: Capstone Project | K7 |  |  | Presentation/Report |
| **P.h.2.A4** | SS.6 | Demonstrates individual responsibilities based on norms of engineering practice. | Affective Level 4 (Organization) | 0.7 | EEE4001: Internship/ Seminar/ Workshop | EEE4000: Capstone Project |  |  |  | Report/Book |

## **PO-i/ PLO 9: Individual Work and Teamwork**

Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

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| **P.i.1.A3** | N/A | Function as effective team member in multi-disciplinary problems. | Affective Level 3 (Valuing) | 0.5 | EEE4000: Capstone Project | EEE4001: Internship/ Seminar/ Workshop |  |  |  | Peer Review Survey with rubrics and supervisor rubrics. |
| **P.i.2.A5** | FS.5 | Demonstrate individual skills as a leader in solving multi-disciplinary problems. | Affective Level 5 (Characterization) | 0.5 | EEE4102: Modern Control Systems Lab | EEE3110: Engineering Shop |  |  |  | OEL/Project |

## **PO-j/ PLO 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.

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| **P.j.1.A2** | SS.1 | Optimize engineering solution by giving and responding to clear instructions.  (Communicate effectively by giving and responding to clear instructions to produce engineering solutions.) | Affective Level 2 (Responding) | 0.4 | EEE4000: Capstone Project | EEE4211: Measurement and Instrumentation Lab |  |  | A1, A3, A5 | Viva/Presentation |
| **P.j.2.P3** | SS.4 | Produce written engineering reports by applying principle-based approaches and design documentation on complex engineering activities for different stakeholders. | Psychomotor Level 3  (Precision) | 0.25 | EEE4000: Capstone Project | EEE4209: Telecommunications Engineering Lab |  |  | A1, A4 | Report |
| **P.j.3.A4** | SS.2 | Make and deliver effective presentation based on complex engineering activities. | Affective Level 4 (Organizing) | 0.25 | BAS 1204: Bangladesh Studies | EEE3110: Engineering Shop |  |  | A1,  A2 | Presentation |
| **P.j.4.P5** | SS.3 | use language flexibly and effectively for social, academic and professional purposes | Psychomotor Level 5 (Naturalization) | 0.1 | EEE2215: Engineering Ethics and Environmental Protection | EEE4000: Capstone Project |  |  |  | Presentation/Report |

## **PO-k/ PLO 11: Project Management and Finance**

Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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| **P.k.1.P4** | TS.1 | Apply engineering management principles and economic decision making to solve engineering projects as a team. | Psychomotor Level 4 (Articulation) | 0.3 | EEE3106: Industrial Electronics and Drives Lab | EEE4000: Capstone Project |  |  |  | Project Report |
| **P.k.2.P4** | TS.2 | Manage multi-disciplinary components of a project as a member/leader. | Psychomotor Level 4 (Articulation) | 0.3 | EEE3110: Engineering Shop | EEE4000: Capstone Project |  |  |  | Project Report |
| **P.k.3.A5** | SS.5 | Demonstrate competency in completing individual engineering project based on relevant management principles and economic models. | Affective Level 5 (Characterization) | 0.4 | EEE4213: Power Stations and Substations | EEE4000: Capstone Project |  |  |  | Project Report |

## **PO-l/ PLO 12: Lifelong 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.

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| **Indicators ID** | **BNQF Indicator** | **Indicators Definition** | **Domain** | **W** | **Course 1** | **Course 2** | **K** | **P** | **A** | **Assessment Technique(s)** |
| **P.l.1.A1** | N/A | Investigate and gather information on a given engineering issue beyond classroom learning. | Affective Level 1 (Receiving) | 0.3 | EEE4209: Telecommunications Engineering | EEE4000: Capstone Project |  |  |  | Assignment/Report |
| **P.l.2.P5** | PS.1 | Seek and use resources in solving engineering problems. | Psychomotor Level 5 (Naturalization) | 0.4 | EEE4211: Measurement and Instrumentation Lab | EEE4000: Capstone Project |  |  |  | Report |
| **P.l.3.A5** | PS.3 | Recognizing the need for continuing education and participation in professional societies and meetings. | Affective Level 5 (Characterization) | 0.3 | EEE4000:  Capstone Project | EEE4001: Internship/ Seminar/ Workshop |  |  |  | **Report** |