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| AIUB-Logo | **AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)**  Faculty of Engineering  Department of EEE and CoE  Undergraduate Program |

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| **COURSE PLAN SPRING 2020-2021 SEMESTER** |

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| **I**. Course Core and Title  **EEE 3102: Digital Electronics Lab**  **II**. Credit  **1 credit hours (3 hours of Laboratory per week)**  **III**. Nature  **Core Course for EEE**  **IV**. Prerequisite  **EEE 2206: Digital Logic Design Lab** |  | **V. Mission: AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB) is committed to provide quality and excellent computer-based academic programs responsive to the emerging challenges of the time. It is dedicated to nurture and produce competent world class professional imbued with strong sense of ethical values ready to face the competitive world of arts, business, science, social science and technology.**  **VI. Vision:** AMERICAN INTERNATIONAL **UNIVERSITY-BANGLADESH (AIUB) envisions promoting professionals and excellent leadership catering to the technological progress and development needs of the country.** |

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| **VII - Course Description:** |

This is core course of Computer Engineering (CoE) and Electrical and Electronic Engineering (EEE) program that presents basic tools for the design of digital circuits. It promotes the knowledge about the design and implementation of digital electronics circuits for practical engineering applications and formulating their solutions.

The goal of this course is to:

• Switching Characteristics of a semiconductor diode and transistor, Cut-off, Active and Saturation

modes, Introduction to Integrated Circuits (ICs).

• Special characteristics of Digital logic families and their comparative discussion.

• Definition and Problem solving on Special Characteristics.

• Basic Diode Transistor Logic Gates: DL, RTL, DTL, Modified DTL, HTL and ECL with operational

detail.

• TTL Logic Gates, Different outputs of TTL open collector, totem-pole, Schottky TTL, Gates with

tri-state output.

• MOS and CMOS Logic with operational detail.

• Basic memory units and operations.

• Memory system: RAM and ROM Family.

• Memory System: Flash Memory, Magnetic and optical storage, USB Flash Drive, SSD & HDD.

• Basics Digital Signal Processing system.

• Analog to Digital and Digital to Analog conversion techniques with application.

• Operation and Mathematical operation of 555 integrated timer circuit: Monostable, Astable multivibrator.

• Introduction to Programmable Logic Devices (PLDs): Advantages & disadvantages over discrete logic gates, Implementation of digital circuits using PLDs (using PAL, PLA, CPLD and FPGA).

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| **VIII – Course Outcomes (CO) Matrix:** |

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|  | By the end of this course, students should be able to: | Level of Domain | | | | POI Assessed |
| C | P | A | S |
| CO1 | Define Integrated circuits, special characteristics of digital logic  families and digital signal processing fundamentals | 1 |  |  |  | PO1 |
| CO2 | Design methodology of logic families, 555 timer and PLD | 5 |  |  |  | PO3 |
| CO3 | Analyze operation of logic families, memory systems, storage  device and 555 timers | 4 |  |  |  | PO2 |
| CO4 | Demonstrate ADC and DAC methodology | 3 |  |  |  | PO2 |
| CO5 | Designing of, different logic gates with logic families (Diode Logic Gate, Bipolar Transistor Logic Gate, MOSFET Logic Gates), digital systems using CMOS (Half adder, SRAM cell), DAC, ADC, digital systems using 555 timer (traffic light  controller, 7 segment display). | 6 | 4 |  | TS | **PO12** |
| *C: Cognitive; P: Psychomotor; A: Affective; S: Soft-skills (CT: Critical Thinking, TS: Teamwork)* | | | | | | | |

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| **X – Topics to be covered in Laboratory Class:** |

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| **Time**  **Frame** | **CO** | **Topics** | **Teaching Activities** | **Assessment** | **Evidence** |
| **WEEK**  **1** |  | Introduction of equipment and tools to be used, and Construction of Diode Logic Gates | Lecture  Tutorial | Digital Electronics wiring connections-based test |  |
| **WEEK**  **2** | CO1 | Construction of Bipolar Transistor Logic Gate | Lecture  Tutorial | Lab report |
| **WEEK**  **3** | CO1 | Construction of MOSFET Logic Gates | Lecture  Tutorial | Lab report |
| **WEEK**  **4** | CO3 | Designing a Half Adder using CMOS | Lecture  Tutorial | Lab report |
| **WEEK**  **5** | CO1 | Deriving logic equations from a given engineering problem and designing with CMOS | Lecture  Tutorial | Lab report |
| **WEEK**  **6** |  | **LABORATORY MID-TERM WEEK** | | | |
| **WEEK**  **7** |  | **MID-TERM WEEK** | | | |
| **WEEK**  **8** | CO3 | Designing a flash Analog to Digital Converter. | Lecture  Tutorial | Digital Electronics wiring connections-based test |  |
| **WEEK**  **9** | CO4 | Designing of Digital to Analog Converter | Lecture  Tutorial | Lab report |
| **WEEK**  **10** | CO4 | To get Familiarized with the 555 timers. | Lecture  Tutorial | Lab report |
| **WEEK**  **11** |  | Designing a simple Traffic Light Controller (TLC) with Timers and  Counters | Lecture  Tutorial | Lab report |
| **WEEK 12** |  | Design of an Irregular Synchronous Counter using 555 Timer. | Lecture  Tutorial | Lab report |
| **WEEK**  **13** | **LABORATORY FINAL-TERM WEEK** | | | | |
| **WEEK**  **14** | **FINAL-TERM WEEK** | | | | |

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| **XI – Course Requirement:** |

At least **80% class attendance** is necessary to sit for the exam. If there is any assignment given to the students, they have to submit it before the deadline decided by the course teacher.

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| **XII – Evaluation Grading System:** |

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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| **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) |

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| **Marking system For Lab Classes (Midterm and Final term)** | |
| Attendance | 10% |
| Lab Report | 30% |
| Individual Presentation / Performance | 30% |
| Midterm/Final term exam  Viva  Quiz | 10%  20% |
| **Total** | 100% |
| **Final Grade/ Grand Total** | |
| Midterm: | 40% |
| Final Term: | 60% |

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| **XIII – Teaching Method** |

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.

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| **XIV – Textbook/ References** |

## Textbooks:

1. Thomas L. Floyd, “Digital Fundamentals” 11th edition, Prentice Hall – Pearson Education.
2. M. Morris Mano, “Digital Logic & Computer Design” Prentice Hall

## References:

1. Ronald J. Tocci & Neal S. Widmer, “Digital Systems” 7 th edition, Prentice Hall
2. Herbert Taub, Donald Schilling, “Digital Integtrated Electronics
3. Stephen Brown & Zvonko Vranesic, 'Fundamentals of Digital Logic with VHDL Design' 2nd Edition, (Chapter- 3)
4. Richard S. Sandige & Michael Sandige, 'Fundamentals of Digital & Computer Design with VHDL', (Chapter- 8)
5. Roger Tokheim, 'Digital Electronics: Principles and Applications'
6. William Kleitz, 'Digital Electronics: A Practical Approach',8th Edition.
7. Robert Dueck and Ken Reid, 'Digital Electronics'
8. James Bignell and Robert Donovan, 'Digital Electronics'
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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| **XVI - List of Faculty Teaching the Course** |

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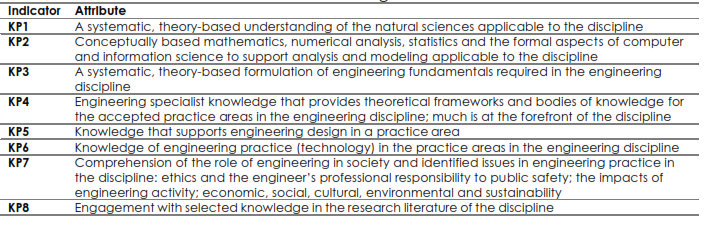
* 1. **Mr. Rabiul Islam**
  2. **Md. Ashif Islam Oni**
  3. **Naheed Islam**
  4. **Nirjhor Rouf**
  5. **Tahmida Islam**

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| **XVII - Verification** |

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| Prepared by  ---------------------------------  Tahmida Islam  Course Coordinator  Date- 07. 02. 2021 | Checked and certified by:  .............................................................  (Prof. Dr. Md. Abdul Mannan)  (Head of Department)  Date:................................................ | Approved by:  .............................................................  Prof. Dr. A B M Siddique Hossain  (Dean of Faculty of Engineering)  Date:................................................... |
|  | Moderated by :  …………………….  Date : ……………………….. | Moderated by :  ……………………….  Date : ……………………….. |

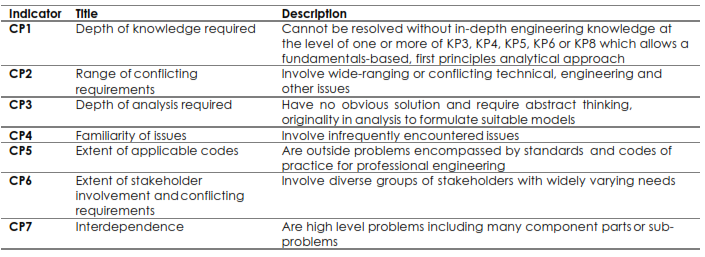
**Appendix A**

***Table 1:*** *Knowledge Profile*

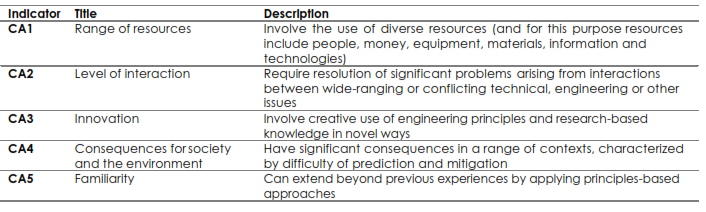


***Table 2****: Range of Complex Engineering Problem Solving*

*Complex Engineering Problems have characteristic CP1 and some or all of CP2 to CP7*



***Table 3:*** *Range of Complex Engineering Activities Complex activities means (engineering) activities or projects that have some or all of the following characteristics*



**PO1: Engineering Knowledge**

Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in KP1 to KP4 respectively to the solution of complex engineering problems

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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.01.1.C3** | Apply information and concepts in *natural science* with the familiarity of issues. | Cognitive Level 3 (Applying) | K1 |  |  |
| **P.01.2.C3** | Apply information and concepts of *mathematics* to solve complex engineering problems with a range of conflicting requirements. | Cognitive Level 3 (Applying) | K2 | CP1, CP2 |  |
| **P.01.3.C3** | Apply information and concepts in  *engineering fundamentals* with the familiarity of issues. | Cognitive  Level 3 (Applying) | K3 |  |  |
| P.01.4.C3 | Apply information and concepts in *specialized engineering sciences* with the in-depth of analysis of a complex engineering problem. | Cognitive Level 3 (Applying) | K4 | CP1, CP3 |  |

**PO2: Problem Analysis**

Identify, formulate, research literature and analyse 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** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.02.1.C4** | Identify and relate first principles of mathematics, natural sciences and engineering sciences to solve complex engineering problems. | Cognitive Level  4  (Analyzing) | K1, K2, K3 | CP1, CP6 |  |
| **P.02.2.C4** | Formulate solutions, procedures,  and methods to solve complex engineering problems | Cognitive Level  4 (Analyzing)) |  | CP1,  CP4 |  |
| **P.02.3.C4** | Analyze and solves complex engineering problems reaching substantiated conclusion | Cognitive Level  4 (Analyzing) | K4 | CP1, CP2 |  |
| **P.02.4.C5** | Research literature and Critically evaluates the validity and accuracy of existing solution methods using specialized engineering knowledge. | Cognitive Level  5 (Evaluating) | K4 |  |  |

**PO3: 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** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.03.1.C2** | Identify the different components or processes of complex engineering problems. | Cognitive Level 2 (Understanding) |  | CP1, CP7 |  |
| **P.03.2.C3** | Develop solution for different components of complex engineering problem. | Cognitive Level 3 (Applying) |  | CP1, CP7 |  |
| **P.03.3.C4** | Develop probable solutions that meet specified needs with appropriate consideration for public health and safety, culture, societal and environmental considerations. | Cognitive Level 4 (Analyzing) | K5 |  |  |

**PO4: 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** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.04.1.P3** | Design Experiment to test complex engineering problem for certain constrains through appropriate research. | Psychomotor Level 3 (Precision) | K8 | CP1, CP2 |  |
| **P.04.2.C4** | Analysis and Interpretation  of collected data to provide valid conclusion acknowledging the limitations. | Cognitive Level  4 (Analyzing) |  |  |  |
| **P.04.3.C6** | Develop and Synthesis of  complex engineering problems using substantial engineering knowledge | Cognitive Level  6 (Creating) |  | CP1,  CP4 |  |

**PO5: 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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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.05.1.C3** | Select and Apply appropriate techniques to solve complex engineering problems using modern engineering tools considering the limitations. | Cognitive Level  3 (Applying) |  | CP1, CP2 |  |
| **P.05.2.P4** | Use engineering tools for prediction and modeling of complex engineering problems considering the practice in electrical and electronic engineering discipline. | Psychomotor Level 4 (Articulation) |  | CP1, CP5 |  |
| **P.05.3.P5** | Create relevant resources for complex engineering problems using modern engineering tools. | Psychomotor Level 5 (Naturalization) | K6 | CP1, CP7 |  |

**PO6: 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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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.06.1.A3** | Accepts and Recognize the role of  engineering in society, health,  safety, legal and culture. | Affective Level  3 (Valuing) |  |  |  |
| **P.06.2.C5** | Design solution for complex engineering problem in accordance with professional practices | Cognitive Level  5 (Evaluating) | K7 | CP1, CP3 |  |

**PO7: 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** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.07.1.C5** | Evaluate sustainability of complex engineering problems considering society and environment. | Cognitive Level  5  (Evaluating) | K7 | CP1, CP2 |  |
| **P.07.2.C5** | Identify impact on society and environment for professional engineering solutions. | Cognitive Level  5 (Evaluating) | K7 |  |  |

**PO8: Ethics**

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

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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.08.1.A5** | Demonstrates knowledge of ethical standards (i.e. Code of Ethics) | Affective Level 5 (Characterization) |  |  |  |
| **P.08.2.A4** | Demonstrates individual responsibilities based on norms of engineering practice. | Affective Level 4 (Organization) | K7 |  |  |

**PO9: Individual and Team work**

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

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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.09.1.A2** | Function as effective team leader/member in multi- disciplinary problems. | Affective Level 2 (Responding) |  |  |  |
| **P.09.2.A2** | Displays good interpersonal skills as a member/leader. | Affective Level 2 (Responding) |  |  |  |
| **P.09.3.A5** | Demonstrate individual skills in solving multi-disciplinary problems. | Affective Level 5 (Characterization) |  |  |  |

**P10: 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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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.10.1.A2** | Demonstrates an ability to effectively give and respond to clear instructions. | Affective Level  2 (Responding) |  |  | CA1, CA3 |
| **P.10.2.P3** | Produces written engineering  reports by applying principle based approaches and design documentation on complex engineering activities for different stake holders. | Psychomotor  Level 3 (Precision) |  |  | CA1,  CA5 |
| **P.10.3.A2** | Perform effective oral presentation on complex engineering activities. | Affective Level  2 (Responding) |  |  | CA2, CA4 |

**P11: 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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| **Indicators ID** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.11.1.P4** | Apply engineering management principles and economic decision making to solve engineering projects as a team. | Psychomotor Level  4 (Articulation) |  |  |  |
| **P.11.2.P4** | Manage multi-disciplinary  projects as a member/leader. | Psychomotor Level  4 (Articulation) |  |  |  |
| **P.11.3.A5** | Demonstrate competency in completing individual engineering project based on relevant management principles and economic models. | Affective Level 5 (Characterization) |  |  |  |

**P12: 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** | **Indicators Definition** | **Domain** | **KP** | **CP** | **CA** |
| **P.12.1.A1** | Investigate and gather information on a given engineering issue. | Affective Level 1 (Receiving) |  |  |  |
| **P.12.2.A4** | Seek and use resources in solving engineering problems. | Affective Level 4 (Organization) |  |  |  |
| **P.12.3.A5** | Recognizing the need for  continuing education and participation in professional societies and meetings. | Affective Level 5  (Characterization) |  |  |  |