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

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| **COURSE PLAN FALL 2021-2022 SEMESTER** |

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| **I.** Course Code and Title  **EEE 3102: Digital Logic and Circuits Lab**  **II.** Credit  **1 credit hours (3 hours of lab per week)**  **III.** Nature  **Core Course for EEE/CoE**  **IV.** Prerequisite  **EEE 2103: Electronic Device** |  | **V. Mission of Faculty of Engineering**: To develop engineers with highest level of commitment toward the betterment of the society by applying science and technology.  To nurture young leaders with perspectives and ethics.  To create and disseminate state of the art knowledge and technical skills with problem solving attitude for a sustainable society.  **VI. Vision of Faculty of Engineering:** The Faculty of Engineering will endeavor to nurture young engineers for innovation and creativity dedicated to problem solving and lifelong learning for research, entrepreneurship, and professionalism with respective communities. |

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| **VII - 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.

**Contents:**

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

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

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| **Cos** | **Details** | **Level of Domain** | | | | **Assessed Program Outcome Indexes (POI)#** | **KP** | **CP** | **CA** |
| **C** | **P** | **A** | **S** |
| CO1 | Identify the performance of different logic gates, ICs and 555 timers | 2 |  |  |  | P.c.1.C2 |  |  |  |
| **CO2** | **Analysis and interpretation of combinational logic circuit data, i.e., different logic circuits, such as logic gates, arithmetic circuits, MUX, DEMUX, encoder, decoder, etc. through appropriate research literature to provide valid conclusion acknowledging the limitations.** | **4** |  |  |  | **P.d.2.C4** | **8** |  |  |
| CO3 | Design the different types of electronic circuits using the logic gate | 3 |  |  |  | P.a.3.C3 |  |  |  |
| *C: Cognitive; P: Psychomotor; A: Affective; S: Soft-skills (CT: Critical Thinking), SL: Strongly linked; ML: Moderately linked; WL: Weakly linked*  # *For details please check the appendix A* | | | | | | |  |  |  |

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| **IX – Topics to be Covered\*:** |

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| **Time Frame** | **CO** | **Topic** | | **Specific Objective(s)** | **Suggested Activities** | **Teaching Strategy(s)** | | **Assessment** | **Evidence** |
| **Week 1** | **CO1** | **Exp. 1** | | **Studying different digital logic gates and designing of basic logic gates using Universal gates** | **The teacher should divide the groups accordingly. Students should be instructed to follow the lab report writing guidelines.** | **Briefly showing in description the pin configuration of IC and use of Bread Board, Trainer Board** | | **Practical implementation of each lab work.** | **Nil** |
| **Week 2** | **CO3** | **Exp. 2** | | **Deriving logic equations and truth table from a given statement or expression.** | **Lab report of previous experiment must be submitted.** | **Lab Report 1** |
| **Week 3** | **CO3** | **Exp. 3** | | **Study of Adder, Subtractor and Comparator Circuits** | **Lab Report 2** |
| **Week 4** | **CO3** | **Exp. 4** | | **Designing Multiplexer (MUX) and Demultiplexer (DEMUX), Encoder and Decoder Circuits** | **Lab Report 3** |
| **Week 5** | **CO2** | **Exp. 5** | | **Open-ended lab: Design of a combinational logic circuit** |  | **Lab Report 4** |
| **Week 7** | **MID-TERM EXAM WEEK** | | | | | | | | |
| **Week 8** | **CO1** | **Exp. 6** | **Construction of Diode and Transistor Logic Gates** | | **Lab report of previous experiment must be submitted.** | **Brief theoretical description, Teaching circuit implementation and use of different tools,**  **Computer simulation and hardware implementation.** | **Practical implementation of each lab work.** | | **Nil** |
| **Week 9** | **CO3** | **Exp. 7** | **Implementation of Asynchronous and synchronous counters using flip-flops** | | **Lab Report 6** |
| **Week 10** | **CO1** | **Exp. 8** | **Construction of MOSFET Logic Gates** | | **Lab Report 7** |
| **Week 11** | **CO3** | **Exp. 9** | **Design and Implementation of Astable Multivibrator using 555 Timer** | | **Lab Report 8** |
| **Week 12** | **CO3** | **Exp. 10** | **Designing of a digital to Analog converter & flash Analog to Digital Converter** | | **Lab Report 9** |
| **Week 14** | **FINAL-TERM EXAM WEEK** | | | | | | | | |

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

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| **X – 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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| **XI – 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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| **Marking system For Laboratory Classes (Midterm)** | |
| Attendance | 10% |
| Lab Report | 30% |
| Open Ended Lab Report (OBE) | 20% |
| Viva | 20% |
| Midterm Written Lab Quiz | 20% |
| **Total** | 100% |
| **Midterm Grade/ Grand Total 40%** | |

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| **Marking system For Laboratory Classes (Final term)** | |
| Attendance | 10% |
| Lab Report | 30% |
| Lab Performance | 20% |
| Viva | 20% |
| Final Written Lab Quiz | 20% |
| **Total** | 100% |
| **Final Grade/ Grand Total 60%** | |

**Grand Total - - - - - - - -40% of Midterm + 60% of Final Term**

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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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| **XII – COs and POs Assessment** |

**COs Assessment Tools for Mid-Term**

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| **Assessment Tools** | **CO Marks** | **Marks for Grading** |
| Attendance | Not counted for Assessment | 10 |
| Lab Report | Not counted for Assessment | 30 |
| **Open Ended Lab Report (OBE)** | 20 | 20 |
| Viva | Not counted for Assessment | 20 |
| Midterm Written Lab Quiz | Not counted for Assessment | 20 |
| **Total** | **20** | **100** |

**COs Assessment System for Final-Term**

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| **Assessment Tools** | **CO Marks** | **Marks for Grading** |
| Attendance | Not counted for assessment | 10 |
| Lab Report | Not counted for assessment | 30 |
| Lab Performance | Not counted for Assessment | 20 |
| Viva | Not counted for assessment | 20 |
| Final Written Lab Quiz | Not counted for assessment | 20 |
| **Total** |  | **100** |

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| **CO4 Marks** | **CO5 Marks** | **P.d.2.C4 Marks** |
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**XIII – Teaching Method**

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.

**XIV – Textbook/ References**

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

References:

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

Digital design – Karim and Johnson

1. Brian Holdsworth and Clive Woods, “Digital Logic Design”-Fourth Edition.
2. Stephen Brown and ZvonkoVranesic, “Fundamentals of Digital Logic with VHDL Design with CD-ROM”
3. William J. Dally and R. Curtis Harting, “Digital Design: A Systems Approach”
4. Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and David Irwin, “Digital Logic Circuit Analysis and Design”
5. John P. Hayes, “Introduction to Digital Logic Design”
6. Norman Balabanian and Bradley Carlson, “Digital Logic Design Principles”

8. Enoch O. Hwang, “Digital Logic and Microprocessor Design with VHDL”

9. Joseph Cavanagh, “Digital Computer Arithmetic: Design and Implementation (Computer Science)”

**XV - List of Faculties Conducting Lab**

1. **Dr. Mohammad Hasan Imam**
2. **Md. Ali Noor**
3. **Mr. Sujan Howlader**
4. **Mohammad Zohurul Islam**
5. **Dr. Md. Rifat Hazari**

**XVI – Verification:**

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| Prepared by  ………………………………...  Course Co-ordinators  Sujan Howlader  Date: 14/09/2021 | Checked and certified by:  ..........................................................  Prof. Dr. M. A. Mannan  Director, Faculty of Engineering  Date: ............................................... | Approved by:  ..........................................................  Prof. Dr. A B M Siddique Hossain  Dean, Faculty of Engineering  Date: ............................................... |
|  | Moderated by:  …………………….  Date: …………………………. | Moderated by:  ……………………….  Date: …………………………. |

# 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 researchbased 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 |

**Program Outcomes** (according to BAETE Manual 2nd Edition)

**PO (a): 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.a.1.C3** | Apply information and concepts in *natural science* with the familiarity of issues. | Cognitive Level 3 (Applying) | K1 |  |  |
| **P.a.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.a.3.C3** | Apply information and concepts in  *engineering fundamentals* with the familiarity of issues. | Cognitive  Level 3 (Applying) | K3 |  |  |
| **P.a.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 |  |

**PO (b): 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.b.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.b.2.C4** | Formulate solutions, procedures,  and methods to solve complex engineering problems | Cognitive Level  4 (Analyzing)) |  | CP1,  CP4 |  |
| **P.b.3.C4** | Analyze and solves complex engineering problems reaching substantiated conclusion | Cognitive Level  4 (Analyzing) | K4 | CP1, CP2 |  |
| **P.b.4.C5** | Research literature and Critically evaluates the validity and accuracy of existing solution methods using specialized engineering knowledge. | Cognitive Level  5 (Evaluating) | K4 |  |  |

**PO (c): 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.c.1.C2** | Identify the different components or processes of complex engineering problems. | Cognitive Level 2 (Understanding) |  | CP1, CP7 |  |
| **P.c.2.C3** | Develop solution for different components of complex engineering problem. | Cognitive Level 3 (Applying) |  | CP1, CP7 |  |
| **P.c.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 |  |  |

**PO (d): 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.d.1.P3** | Design Experiment to test complex engineering problem for certain constrains through appropriate research. | Psychomotor Level 3 (Precision) | K8 | CP1, CP2 |  |
| **P.d.2.C4** | Analysis and Interpretation  of collected data to provide valid conclusion acknowledging the limitations. | Cognitive Level  4 (Analyzing) |  |  |  |
| **P.d.3.C6** | Develop and Synthesis of  complex engineering problems using substantial engineering knowledge | Cognitive Level  6 (Creating) |  | CP1,  CP4 |  |

**PO (e): 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.e.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.e.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.e.3.P5** | Create relevant resources for complex engineering problems using modern engineering tools. | Psychomotor Level 5 (Naturalization) | K6 | CP1, CP7 |  |

**PO (f): 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.f.1.A3** | Accepts and Recognize the role of  engineering in society, health,  safety, legal and culture. | Affective Level  3 (Valuing) |  |  |  |
| **P.f.2.C5** | Design solution for complex engineering problem in accordance with professional practices | Cognitive Level  5 (Evaluating) | K7 | CP1, CP3 |  |

**PO (g): 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.g.1.C5** | Evaluate sustainability of complex engineering problems considering society and environment. | Cognitive Level  5  (Evaluating) | K7 | CP1, CP2 |  |
| **P.g.2.C5** | Identify impact on society and environment for professional engineering solutions. | Cognitive Level  5 (Evaluating) | K7 |  |  |

**PO (h): 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.h.1.A5** | Demonstrates knowledge of ethical standards (i.e. Code of Ethics) | Affective Level 5 (Characterization) |  |  |  |
| **P.h.2.A4** | Demonstrates individual responsibilities based on norms of engineering practice. | Affective Level 4 (Organization) | K7 |  |  |

**PO (i): 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.i.1.A2** | Function as effective team leader/member in multi- disciplinary problems. | Affective Level 2 (Responding) |  |  |  |
| **P.i.2.A2** | Displays good interpersonal skills as a member/leader. | Affective Level 2 (Responding) |  |  |  |
| **P.i.3.A5** | Demonstrate individual skills in solving multi-disciplinary problems. | Affective Level 5 (Characterization) |  |  |  |

**PO (j): 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.j.1.A2** | Demonstrates an ability to effectively give and respond to clear instructions. | Affective Level  2 (Responding) |  |  | CA1, CA3 |
| **P.j.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.j.3.A2** | Perform effective oral presentation on complex engineering activities. | Affective Level  2 (Responding) |  |  | CA2, CA4 |

**PO (k): 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.k.1.P4** | Apply engineering management principles and economic decision making to solve engineering projects as a team. | Psychomotor Level  4 (Articulation) |  |  |  |
| **P.k.2.P4** | Manage multi-disciplinary  projects as a member/leader. | Psychomotor Level  4 (Articulation) |  |  |  |
| **P.k.3.A5** | Demonstrate competency in completing individual engineering project based on relevant management principles and economic models. | Affective Level 5 (Characterization) |  |  |  |

**PO (l): 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.l.1.A1** | Investigate and gather information on a given engineering issue. | Affective Level 1 (Receiving) |  |  |  |
| **P.l.2.A4** | Seek and use resources in solving engineering problems. | Affective Level 4 (Organization) |  |  |  |
| **P.l.3.A5** | Recognizing the need for  continuing education and participation in professional societies and meetings. | Affective Level 5  (Characterization) |  |  |  |