**School of Interdisciplinary Engineering and Sciences (SINES)**
**National University of Sciences & Technology (NUST)**

*Title :* Product Development & Systems Engineering

**Pre-requisite:** Nil

**Objectives:** This course is intended to prepare the student for a comprehensive understanding of the principles, methodologies, and best practices involved in Product Development and Systems Engineering, and to enhance collaboration and communication skills necessary for working in multidisciplinary teams.

**Outcomes:** The course is designed to develop the understanding of best practices involved in Product Development and Systems Engineering, acquire practical skills, and develop project management skills specific to product development and system engineering.

**Course Code:** SYSE-818

**Credit Hours:** 3-0

**Course Contents with proposed contact Hours (Weekly plan):**

1. Introduction to Product Development and System Engineering: (3 hours)
   Overview of the course objectives, content, and expectations, Systems Engineering landscape, introduction to systems thinking and its application in product development.
2. Systems Engineering Principles: (3 hours)
   Understanding the fundamental principles and concepts of systems engineering, System requirements analysis and management
3. System Architecture and Design: (2 hours)
   System architecture development and evaluation, Design methodologies and trade-off analysis
4. Product life cycle: (2 hours)
   An overview of the product life cycle
5. Product Design and Development Process: (2 hours)
   Overview of the product design and development process, Market analysis and identification of customer needs
6. Concept Generation: (3 hours)
   Concept generation process, Techniques for generating concepts
7. Concept Selection: (3 hours)
   Concept selection process, Concept screening and concept scoring, Concept selection and decision-making
8. Concept Testing: (3 hours)
   Choosing the survey population and survey format, Communicate the concept, Measure and interpret customer response
9. Product Architecture and Integration: (3 hours)
   Designing the product architecture and subsystem integration, Modular vs. Integral Architecture, Managing interfaces and dependencies
10. Robust design: (3 hours)
    Taguchi's robust design, Control factors, Noise factors, Performance metrics, Design of Experiments
11. Manufacturing and Production: (3 hours)
    Manufacturing considerations in product development, Production planning, quality

control, and supply chain management

12. Sustainment and Life Cycle Management: (3 hours)
    Product sustainment strategies and life cycle management, Reliability, maintainability, and obsolescence management
13. Disposal and Sustainability: (3 hours)
    Disposal and end-of-life considerations for products and systems, Environmental sustainability and responsible product lifecycle management
14. Product development economics: (6 hours)
    Net present value, Base case financial model, Sensitivity analysis and trade-offs
15. Project Management in Product Development (6 hours)
    - Project planning, scheduling, and resource management
    - Design structure matrix, Gant charts, PERT charts
    - Risk assessment and mitigation in product development projects

**Details of lab work/workshop practice, if applicable:**

Not Applicable

**Recommended reading, including textbooks, reference books with dates**

- *Systems Engineering Principles and Practice* by Alexander Kossiakoff, Steven M. Biemer, Samuel J. Seymour, David A. Flanigan, 3rd Edition, 2020, John Wiley & Sons Inc.
- *Product Design and Development,* by Karl Ulrich and Steven Eppinger, 7th Edition, 2020, McGraw Hill Education
- *INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities*, by David D. Walden, Garry J. Roedler,R. Douglas Hamelin, Thomas M. Shortell, 4th Edition, 2015, John Wiley & Sons Inc.
- Guide to the Systems Engineering Body of Knowledge (SEBoK), Version 2.7 Oct. 2022 Editor: Robert J. Cloutier

**Nature of Assessments**

Assessment will be carried out as per NUST statutes