SYSTEMS ENGINEERING: THEORY & PRACTICE

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Department of Design Programme
IIT Kanpur

INDUSTRY SUPPORT: HAL, BHEL, BEL, L&T, Automotive companies, Aerospace and defense companies, DRDO, Boeing, Lockheed, Airbus, Brahmos, ISRO, VSSC, etc.

PREREQUISITES: The student should have either completed an engineering degree or is enrolled in the program and have completed at least six semesters of the curriculum

INTENDED AUDIENCE: Students of all engineering disciplines, specically, Aerospace, Mechanical, Electrical, Civil, Chemical, and Computer Science

COURSE OUTLINE :

Systems engineering is a discipline that utilizes an inter-disciplinary problem-solving approach across the entire technical effort irrespective of whether the systems or the systems of systems are for military, industrial, commercial or civil applications. This course will provide an overview of both theory and practice of the systems engineering discipline along with systems engineering design approach.

ABOUT INSTRUCTOR :

Prof. Deepu Philip is a faculty of Industrial & Management Engg. Department and Design Programme of IIT Kanpur. He works in the area of Production and Operations, Systems Simulation, Product Life Cycle Management, Unmanned Aerial Systems, and Systems Engineering. He holds Bachelor degree in Industrial Engineering with his doctorate in Industrial & Management Engineering from MSU Bozeman. He has both academic and industrial experience with leading organizations of the world. He has experience in designing and implementing complex system of systems in different fields including defense, aviation, fertilizer, strategic chemical plants, transportation, banking, automation, health care, energy, and communication.

COURSE PLAN

Week 1 : Systems engineering – what is, origin, and examples; Systems engg as a profession Power of systems engg and examples; Systems engg viewpoint, perspectives, domains; Systems engg fields, approaches, activities, and products

Week 2 : Complex system structure-building blocks, hierarchy, interfaces; Complex system structure-environment, interactions, complexity; System development process–life cycle,evolutionary characteristics; Systems engg method; Systems testing throughout development

Week 3 : Managing systems development, risks, work breakdown structure (WBS), systems engg management plan (SEMP) Systems risk management, organizing for systems engg; Need analysis – originating, operations, functional, and feasibility Need validation, systems ops requirement; System requirements development, performance requirements

Week 4 : Implementing concept exploration, validating requirements; Concept definition – selection and validation, functional analysis and allocation ; Systems architecture, system modeling languages, Model-Based Systems Engg (MBSE) Decision making, modeling for decisions; Simulation, Trade-off analysis

Week 5 : Engg development stage – program risk reduction, prototype development for risk mitigation Development testing, risk reduction; Revision of functional analysis and design; Overview of probability data analysis; Hypothesis testing

Week 6 : Engineering design – implementing system building blocks, component design; Design validation, change management; Concepts of reliability, redundancy; Concepts of maintainability, availability, producibility; User interface design and GUI

Week 7 : Integration, testing and evaluating total system; Test planning and preparation, system integration Developmental and operational test and evaluation; Engineering for production, transition from development to production Production operations - 1

Week 8 : Production operations - 2; Installation, maintenance and upgrading; Installation testing; In-service support Upgrades and modernization