

Module Information	
Module Title	Principles of Systems Engineering
Module Code	ESE501

1. MODULE SUMMARY

Aims and Summary

This module intends to prepare students to apply and analyse the principles of systems engineering in the development of integrated electronic system. Students will be taught the principles involved in step-by-step development process for the design of an integrated electronic system including concept development, concept exploration, engineering design & development of a system for the specified requirements. The process of system integration, evaluation, testing, software system engineering and engineering management will be discussed. The life-cycle top down systems engineering approach for streamlining the design and development process for enhanced quality, cost effectiveness and reliability will also be emphasised.

Module Size and Credits

Module size	Single
CATS points	12
ECTS credits	N/A
Open / restricted	Restricted
Availability on/off campus	On Campus/Off campus
Total student study hours	120
Number of weeks	4 weeks Full-time or 8 weeks Part-time.
Centre responsible	Centre for Electronic Systems Design Engineering/ Department of Electronics and Communication Engineering
Academic Year	2009

Entry Requirements (pre-requisites and co-requisites)

Normally to be qualified for entry to the Postgraduate Engineering Programme

Excluded Combinations

None

Composition of Module Mark (including weighting of components)

Full-time / Part-time : 50% Written Examination and 50 % Assignment

Pass Requirements

A minimum of 40 % marks in the written examination and a minimum of 40% marks in the assignment are required for a pass and overall 40% marks

Special Features

80% attendance in theory and 80% attendance in laboratory are required.

It is likely that considerable time will be spent in School facilities outside of normal timetabled class time.

Courses for which this module is mandatory

M.Sc. [Engg] in Electronic Systems Design Engineering

Courses for which this module is a core option

None

2. TEACHING, LEARNING AND ASSESSMENT

Intended Module Learning Outcomes

After undergoing this module, students will be able to:

1. Explain principles of system engineering in the development of an integrated electronic system
2. Analyse the system development process involved in concept definition, engineering design, engineering development stage, integration, evaluation, testing and production for a system requirements
3. Evaluate the life-cycle top down systems engineering approach for streamlining the design and development process for enhanced quality, cost effectiveness and reliability
4. Describe the importance of both technical and management thrust for the successful implementation of systems engineering

Indicative Content

Class Room Lectures

- 1. Foundations of Systems Engineering:** Definition of System Engineering, Origins of Systems Engineering, Examples of Systems Requiring Systems Engineering, Systems Engineering Viewpoint, Systems Engineering as a Profession, The Power of Systems Engineering.
- 2. Structure of Complex Systems:** System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, System Environment, Interfaces and Interactions.
- 3. The System Development Process:** Systems Engineering Through the System Life Cycle, System Life Cycle, Evolutionary Characteristics of the Development Process, The Systems Engineering Method, Testing Throughout System Development
- 4. Systems Engineering Management:** Managing System Development and Risks, Work Breakdown Structure (WBS), Systems Engineering Management Plan (SEMP), Risk Management, Organization of System Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering Standards.
- 5. Concept Development Stage - Needs Analysis:** Originating a New System, Operations Analysis, Functional Analysis, Feasibility Definition, Needs Validation, System Operational Requirements.
- 6. Concept Exploration:** Developing the System Requirements, Operational Requirements Analysis, Performance Requirements Formulation, Implementation Concept Exploration, Performance Requirement Validation.
- 7. Concept Definition:** Selecting the System Concept, Performance Requirements Analysis, Functional Analysis and Formulation, Concept Selection, Concept Validation, System Development and Planning, System Functional Specifications
- 8. Engineering Development Stage - Advanced Development:** Reducing Program Risks, Requirement Analysis, Functional Analysis and Design, Prototype Development, Development Testing, Risk Reduction.
- 9. Engineering Design:** Implementing the System Building Blocks, Requirement Analysis, Functional Analysis and Design, Component Design, Design Validation, Configuration Management.
- 10. Integration and Evaluation:** Integrating, Testing and Evaluating the Total System, Test Planning and Preparation, System Integration, Developmental System Testing, Operational Test and Evaluation.
- 11. Post Development Stage – Production:** Systems Engineering in the Factory, Engineering for Production, Transition from Development to Production, Production Operations, Acquiring a Production Knowledge Base.
- 12. Software System Engineering:** Coping with Complexity and Abstraction, Nature of Software Development, Software Concept Development: Analysis and Design, Software Engineering Development: Coding and Unit Test, Software Integration and Test, Software Engineering Management.
- 13. Systems Engineering Decision Tools:** Modelling Throughput System Development, Modelling, Simulation, Trade-off Analysis.

Laboratory Practice

1. Functional analysis of a system
2. Failure mode, effects, and criticality analysis (FMECA)
3. Fault-Tree Analysis (FTA)
4. Reliability - Centered maintenance (RCM)
5. Maintenance task analysis (MTA)
6. Design evaluation of alternatives
7. Life-cycle cost analysis (LCCA)
8. Design Review Checklist

Teaching and Learning Methods

1. Theoretical Knowledge [~30% of module time]
 - a. Face to face lectures from a module leader- 30 hours
 - b. Case study teaching and discussion from a practicing engineer- 6 hours

36 hours

2. Laboratory Practice (Skills) [~ 25% of module time]

30 hours

3. Application Orientation and Problem Solving [45% of module time]
 - a. Reading
 - b. Research
 - c. Written Examination
 - d. Assignment Solving and Documentation

54 hours

Method of Assessment

Part-A

Written Examination [50% Weightage]

At the end of the module, normally on the last day of the last week of the module, written examination is conducted to test students' understanding of taught theoretical concepts. The question paper will comprise either or a combination of the following:

- 6 questions, out of which 5 questions need to be answered
- Practical laboratory work
- Presentations
- Field work
- Creation of a physical model

The marks scored by the student will be scale down to 50% weight.

Part –B

Assignment [50% Weightage]

Students are required to submit word processed assignment report on formally announced last day of the module. Assignment tests students' problem solving skills based on taught concepts. The assignment is assessed for 100 marks but scored marks is scaled down to 50%

Assessment				
Learning Outcomes	1	2	3	4
Part A	X	X	X	X
Part B	X	X	X	X

Both written examination scripts and assignment reports will be double marked/valued

Re-assessment

A minimum of 40 % marks in the written examination and a minimum of 40% marks in the assignment are required for a pass in the module.

A student failing in any one of the components or both is considered as FAIL in the module. A failed student is required to retake the module at the next opportunity. A maximum of 3 attempts including the original are allowed.

Date of Last Amendment

May 2009

3. MODULE RESOURCES

Essential Reading

1. Module Notes

Recommended Reading

Books

1. Alexander Kossiokoff and William N. Sweet, *Systems Engineering: Principles and Practice*, John Wiley & Sons, 2003
2. Benjamin S. Blanchard, *System Engineering Management*, 4th edition, John–Wiley & Sons, 2008
3. M. Jamshidi (Editor), *Systems of Systems Engineering: Innovations for the 21st Century*, John - Wiley & Sons, 2009

Journals

1. Journal of Systems Engineering, Wiley Interscience for INCOSE, <http://www3.interscience.wiley.com/journal/39084/home>
2. International Journal of System of Systems Engineering (IJSSE), Inderscience Publishers, <http://www.inderscience.com/ijse/>

Magazines

Internet Sites

1. Wikipedia main entry for Systems Engineering, http://en.wikipedia.org/wiki/Systems_Engineering
2. INCOSE: International Council for Systems Engineering, <http://www.incose.org/>

Laboratory

Hardware: PCs

Software: Systems Engineering Decision Tools

Software Manual:

4. MODULE ORGANISATION

Module Leader

Name	Dr. Govind R. Kadambi
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Date and Time of Examination

As per time table

Subject Quality and Approval Information

Subject Quality Group / Subject Board	Electronics and Communication Engineering
Subject Assessment Board	Postgraduate Engineering Programmes

Shortened title

Date of approval by MARP

May 2009