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PENS

Pathway in Enterprise Systems Engineering

Pathway in Enterprise Systems Engineering (PENS)

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Pathway in Enterprise Systems Engineering. Program Specification

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1 The Enterprise Systems Engineering Pathways Intended Learning Outcomes.

1.1 Knowledge

On successful completion of this pathway the graduate will:

- List and define the main enterprise's functionalities and processes
- List and define a wide range of Enterprise Systems Engineering (ESE) concepts
- explain the way these are combined in the overall process of ESE
- Describe and discuss standards, architectures, processes, data, platforms, and their integration.
- Outline and discuss project management, change management decision making and innovation principles and foundations.
- Identify main Security issues and know corresponding solutions

1.2 Know-How and Skill

On successful completion of this programme the graduate will:

- Analyze ESE problems
- Propose and apply solutions
- communicate effectively proposed solutions.
- Evaluate results of applying solutions
- Confidently engage in ESE projects in both technical and organizational aspects

1.3 Competence

On successful completion of this pathway the graduate will be able

- to apply concepts and skills learnt in a variety of contexts
- appreciate the importance of professional development and of the resources available to keep up to date with new developments in ESE
- be able to work independently and also effectively in a team with ethics respect

2 The Program themes.

The following themes were identified.

1. System Thinking and Simulation
2. Business Process Engineering
3. Enterprise Systems
4. Digital transformation
5. Enterprise Systems Development
6. Enterprise Systems Security
7. Data Analytics
8. System Interoperability and integration
9. Project Management
10. Technology Innovations and trends

2.1 Program Learning outcome.

On completion of the ESE pathway, students will be able to:

1. System Thinking and Simulation – Program Learning outcome (PLO): Describe accurately the process of systems thinking, explain what is distinctive about systems thinking in comparison to other forms of teaching and justify why systems thinking and simulation is essential for analyzing and improving situations.
2. Business Process Engineering – PLO: Demonstrate an understanding of main BPE concepts, show ability to construct business processes at enterprise level and critically reflect on how reengineering business processes can benefit an enterprise.
3. Enterprise Systems – PLO: Describe key aspects of Enterprise Systems, critically reflect on the use of such systems in organizations and suggest strategies for the deployment of such systems.
4. Digital transformation – PLO: Explain how digital technologies became drivers for business efficiency, demonstrate how digital transformation can be a destructive force for businesses and critically reflect on the role of technology on business innovation.
5. Enterprise Systems Development – PLO: Identify factors affecting the development of Enterprise Systems, critically reflect the benefits from developing Enterprise Systems and provide evidence on how process improvement can be achieved with system integration.
6. Enterprise Systems Security – PLO: Articulate the main aspects of enterprise systems security, demonstrate ability to assess an organization's security vulnerabilities and evaluate the different causes for security concerns at enterprise level.

7. Data Analytics – PLO: Extract, transform and load data, justify the selection of appropriate methods and models for analyzing data and use data for providing solutions to business problems.
8. System Interoperability and integration – PLO: Describe the main concepts associated with interoperability and integration of enterprise systems, critically reflect on factors affecting the integration of systems at enterprise level and assess the interoperability of enterprise systems.
9. Project Management – PLO: Demonstrate in depth understanding of a project’s lifecycle, identify factors affecting the successful completion of a project and justify their choice of appropriate methods, practices and techniques for managing project activities.
10. Technology Innovations and trends – PLO: Assess the impact of technology innovation for businesses, identify and evaluate the sources of innovation competence at enterprise level, as well as compare and contrast most recent trends in using technology in an entrepreneurial way.

2.2 Program Courses.

Based on the themes and program learning outcomes described above, the following courses were identified.

Course Code	Course Title
C1	Systems and data integration
C2	Digital Business Transformation
C3	Enterprise System Architecture
C4	Engineering of Business Processes
C5	Enterprise Systems
C6	Business Intelligence and data analytics
C7	System Modelling and Simulation
C8	Systems Security and Availability

2.3 Course Learning Outcomes Matrix.

The table below shows a matrix of the Learning Outcomes and their relations with the program courses.

Learning Outcomes	C1	C2	C3	C4	C5	C6	C7	C8
Understand the foundational security requirements of confidentiality, integrity and availability, and the various access control models, terminologies, best practices, tools, and network considerations to control accessing to network services and information.								X
Describe the common cryptographic encryption and decryption algorithms and the tools to ensure data integrity such as hashing, symmetric and asymmetric encryption, certificates, and methods of implementing cryptography								X
Apply knowledge of various security aspects of operations, physical, human, audit, network, securing Web applications, securing e-mail from e-mail attacks, and concerns about networking software to protect an organization's assets.								X
Implement mechanisms to secure information, applications, and services such as implementing access control lists, firewalls, proper management of backups and restores, data encryption, and implementing secure protocols.								X
Explain security classification levels, documents, business continuity plans, risk management considerations, incident response, software development concerns, and management of employees								X
Examine software tools that can be used to test and monitor the vulnerability of systems, networks and logs that provide systems administrator with facilities to track and audit a variety of events on systems								X
Recognize the role of business intelligence and data analytics in assisting the organizations in decision making process.						X		

Identify the different types of BI methods and their adoption in real life projects						X		
Analyze and clean gathered data from different resources and prepare it.						X		
Apply various tools of data analytics and visualization						X		
Evaluate and use appropriate machine learning algorithms and techniques and apply them with leading business intelligence tools to support decision making						X		
Know fundamental concepts, principles, and terminology of data integration	X							
Identify commonly used tools, methods and strategies for integrating data and systems, describing the benefits of using each.	X							
Know and understand enterprise systems, applications as well as data integration issues and assess their interoperability degree and compliance to standardized architectures	X							
Know and understand the role of middleware solutions to solve integration issues and provide an overview of the entire process of data integration from analyzing the problem to implementation and explain its relevance	X							
Lead and manage within a group of peers or even within an industrial context, fully defined integration projects and present/demonstrate the proposed solution	X							
Assess whether learnt integration solutions could fit into newly defined integration projects and issues and apply methodologies either individually or in groups to find other new trends and propose possible solutions and also raise awareness relatively to data privacy and security	X							
Understand the foundations of enterprise systems, explain key concepts and roles enterprise systems play within an organization; describe characteristics and risks of ES, outsourcing and its business and cultural implications, software tools that can be used by enterprise to run their operations more efficiently					X			

Describe the factors that lead to the development and implementation of ERP systems and discuss the advantages and disadvantages of ERP system, ERP architecture, the evolution of information systems technology generations and architectures					X			
Analyzing and identify critical success factors in ERP implementation tools and methodology, project planning, the role of ERP systems in systems integration, change management, production, and sales business processes, implementation approaches, the skills needed to be a project manager, auditing process.					X			
Understand the supply chain management, importance, component, integration, main activities, the ordering problem, inventory management and the delivery in the supply chain. The role of E-Business in supply chain management (E-SCM). Know the different level of supply chain integration.				X	X			
Understand the customer relationship philosophy, types, technologies, applications, strategies in Sales and marketing, CRM lifecycle					X			
Review the Systems Development Life Cycle (SDLC), the key issues in ERP implementation strategy. Compare and contrast SDLC and ERP Life Cycles. Value the transition from developing a system to supporting it in a production environment.					X			
Recognize and explain recent trends in business management		X						
Recognize and explain recent trends in ICT.		X						
Recall and exemplify relevant knowledge about ethical aspects of digital society		X						
Carry out a procedure for innovating and dealing with market disruption		X						
Organize digital business strategy driving advancement		X						
Judge an enterprise digital state (highlight strengths and weaknesses)		X						
Reorganize processes for the whole coherence of the digital transformation Plan and produce with actors of the Digital society		X						

Design and develop enterprise systems using intra-enterprise integration technology			X					
Design and develop enterprise systems using web services technology.			X					
Design and develop enterprise systems while respecting REST principles.			X					
Design and develop enterprise systems using cloud computing and virtualization technologies.			X					
Apply IoT techniques to integrate connected objects to enterprise systems.			X					
Apply appropriate architectural choices and technologies for building and integrating Enterprise Systems (ES).			X					
Improve enterprise business IT alignment, governance, and flexibility to changes by adopting and implementing Process Aware Information Systems (PAIS) principles and methods				X				
Design and model business processes using BPMN 2.0.				X				
Analyze BP models quantitatively and qualitatively.				X				
Implement and automate BP using workflow management systems.				X				
Apply relevant techniques for monitoring and mining BP executions.				X				
Apply model-based and mining-based techniques to improve BP.				X				
Define problems in logistic, supply chain management and finance with specific objectives and constraints					X		X	
Analyze different optimizing problems by using tools such as excel spreadsheets							X	
Interpret the optimal solutions given by computer from the management perspective							X	
Practice decision analysis in the face of uncertain environment							X	
Understand simulation by asking what-if questions about the change of the system							X	

2.4 Program Plan and Course Sequence

Course	Remarks on pre-requisite knowledge	Semester
C2: Digital Business Transformation.	Should have some enterprise systems basics but both courses can run in parallel	S1
C5: Enterprise Systems.	NO REQUIREMENTS	S1
C1: Systems and data integration		S2
C4: Engineering of Business Processes		S2
C3: Enterprise System Architecture.	Foundations on systems integration Enterprise systems knowledge	S3
C6: Business Intelligence and data analytics	Statistics foundations and DB knowledge	S3
C7: System Modelling and Simulation.		S4
C8: Systems Security and Availability.		S4