COURSE STRUCTURE MASTER PROGRAM INDUSTRIAL ENGINEERING

Course	SKS	Specialization				
		IE Innovation and Ergonomics	SPL Production Systems and Logistics	MI Industrial Management	RDK Data and Quality Engineering	RS System Engineering
1st Semester						
System Thinking	3					
Research Methodology	3					
Operation Management	3					
Industrial System Engineering	3					
2nd Semester						
Advance Operation Research	**3**					
Advance Statistics	**3**					
Specialization Compulsory 1	3	Safety Engineering and Management	Manufacturing System	Industrial Economics	Data Mining	Decision and Risk in System Engineering
Specialization Compulsory 2	3	Industrial Technology Management	Inventory System	Industrial Resource Management	Data Engineering	System Based Analysis
3rd Semester						
Specialization Compulsory 3	3	Product and Service Innovation	Logistics System	Industrial Project Development	Reliability and Quality	System Engineering Management
Specialization Compulsory 4	3	Macro Ergonomics	Transportation System	Industrial Strategic Management	Multivariate Data Analysis	Performance Analysis and Modeling
Specialization Electives 1	2	• Knowledge Management • Cognitive Ergonomics • Technopreneurship • Human Performance Engineering	• Total Quality Management • Lean Manufacturing • Industrial Organization • Maritime Logistics	• Corporate Finance • Enterprise Information System • Maintenance Management • Supply Chain Management	• Decision Uncertainties and Risk • Consumer Relationship Management • Advance Optimization	• Conceptual System Planning • Resource and Logistic Support for System Engineering • Game Theory • Technology Policy Modeling using Dynamic System
Specialization Electives 2	2					
4th Semester						
Thesis	8					
Publication	2					

Course Syllabus

SYSTEM THINKING (3 SKS)
Learning Objective(s) : Course participants are able to implement soft OR concept which is SSM (Soft System Methodology) as a thinking pattern to understand a systemic problem.
Syllabus: System Thinking Concept. Concept of Learning. Organization Hard OR vs Soft OR. Causal Loop Diagram. System Archetypes. Behavior Overtime Graph (BoT). SSM (Soft System Methodology): Entering the problem situation, Expressing the problem situation, Formulating root definitions of relevant systems, Building Conceptual Models of Human Activity Systems, Comparing the models with the real world, Defining changes that are desirable and feasible and Taking action to improve the real world situation.
Text Book(s):
1. The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization, Peter M. Senge, Crown Business, 1994
2. Soft Systems Methodology in Action, Peter Checkland, Wiley, 1999

RESEARCH METHODOLOGY (3 SKS)
Learning Objective(s): Course participants are able to understand the basic steps necessary for a scientific research and publications and prepare themselves for the upcoming Thesis as part of the pre-requisites on receiving the master degree
Pre-requisite(s): Please Read Thesis SOP
Text Book(s):
1. Manual Penyusunan Tesis Universitas Indonesia dan Departemen Teknik Industri, 2008.

OPERATIONS MANAGEMENT (3 SKS)
Learning Objective(s): Course participants are able to analyze, design, and operate productive systems in order to create competitive products and services.
Sylllabus: Introduction: transformation processes. Aggregate planning & optimization. MPS & MRP. Process analysis & performances. Production processes. Little's Law, process & queing models. Supply chain processes & performances Location. Distribution system & logistics. Inventory policy decision. Theory of costraints (TOC). Service process selection. Case study.
Prerequisite(s): -
Textboks:
1. Operations & Supply Chain Management; Jacobs, Chase; Irwin McGraw-Hill; 13th Ed., 2011.
2. Operations Management; Nigel Slack, Stuart Chambers, Robert Johnston; Prentice Hall; 2010.
3. Operations Management – Along the Supply Chain; Roberta S. Russel; Bernard W. Taylor; John Wiley & Sons, Inc.; 6th Ed., 2009.

INDUSTRIAL SYSTEM ENGINEERING (3 SKS)
Learning Objective(s): Course participants are able to analyze implementation of NPD Process in an organization and know the approaches, tools and techniques used in each steps of the process according to the needs and characteristics of the organization in order to achieve competitive advantage.
Syllabus: Introduction to NPD Process, Models of NPD Process, Detail Design of of Stage-Gate Model dan Concurrent Engineering, Value Engineerng, Spiral NPD Model, Case Studies Implementation NPD.
Textbook(s):
1. Trott, P. (2008). *Innovation Management and New Product Development*, 4th Edition.
2. Cooper, R.G. (2011), *Winning at New Products: Creating Value Through Innovation*, 4th Edition.
3. Park, R.J.(1998), Value Engineering: A Plan for Invention, St.LuciePress.
2. Morgan, R.M, Liker,J.K (2006). *The Toyota Product Development System: Integrating People, Process and Technology*

INDUSTRIAL TECHNOLOGY MANAGEMENT (3 SKS)
Learning Objective(s): : Course participants are able to understand the steps of technology management in an organization.
Syllabus: State of the art 'Technology Management', Strategy in Technology Management, Technology Intelligence, Technology assessment, Technology Roadmapping, Usage of Technology in Innovation
Textbook(s):
1. Strategic Management of Technological Innovation: Melissa A. Schilling, 3rd Edition, 2010.

2. Product Innovation and Technology Strategy: Robert G. Cooper and Scott J. Edgett, 2009.
3. Tidd, J., Bessant, J., Pavitt, K. (2001). Managing Innovation – Integrating Technological, Market and Organisational Change, Second Edition, John Wiley & Sons Ltd., West Sussex, England.

ADVANCED OPERATIONS RESEARCH (3 SKS)
Learning Objective(s): Course participants are able to understand and implement mathematical model to optimize problem-solving within industrial management and technical issues, which later can be modeled quantitatively, deterministically and stochastically.
Syllabus: Dynamic Programming. Markov Analysis. Decision Tree. Game Theory. Non Linear Programming. Queue. Simulation.
Pre-requisite(s): -
Text Book(s):
1. Hamdy A. Taha, Operations Research, 7th

MACRO ERGONOMICS (3 SKS)
Learning Objective(s): Course participants are able to understand comprehensively about work system design that consists of interacting variables such as hardware and software within internal and external physical environment, organization structure and process in order to make it better. Ability to understand how to implement ergonomic science.
Syllabus: Introduction to macroergonomics, method and tools that are used in work system design and analysis, introduction to organization integration in productivity, safety, health and quality of work life context
Text Book(s):
1. Hendrick, W.H,. Kleiner, Brian, (2002). *Macroergonomics: Theory, Methods, and Applications (Human Factors and Ergonomics)*
2. Stanton, N,. Hedge, A, (2005). *Handbook of Human Factors and Ergonomics Methods*, CRC Press LLC.

ADVANCED STATISTICS (3 SKS)
Learning Objective(s): Course participants are able to organize the collection, process, and analysis of data using statistics and engineering principles to support decision making process, within DOE - Design of Experiment.
Syllabus: Review of Basic Statistical Concepts. Single Factor Experiment (Fixed Effect Model). Single Factor Experiment (Random Effect Model). Randomized Complete Block Design. Latin Square Design. General Factorial Design. 2k Factorial Design. Blocking in Factorial Design. Factorial Experiments with Random Factors. Fractional Factorial Design. Nested Design. Response Surface Model.
Pre-requisite(s): -
Text Book(s):
1. Design and Analysis of Experiments, Douglas C. Montgomery. John Wiley & Sons, 2000
2. Design and Analysis of Experiments, Angela Dean and Daniel Voss, Springer-Verlag, 2000
3. Experimental Design with Applications in Management, Engineering, and the Sciences, Paul D. Barger and Robert E. Maurer, Thomson Learning, 2002

SAFETY ENGINEERING AND MANAGEMENT (3 SKS)
Learning Objective(s): Course participants are expected to understand about the importance of work safety in various work fields. Students are also able to do observation, evaluation, and analysis of work safety program to enhance the benefit, in order to achieve effective and efficient work safety program and human-centered focus. Students also are able to understand about management and engineering design concept which is related to occupational safety in an industrial organization through suppression in control of hazardous materials, safety consideration in production facility and maintenance, and operation of effective safety program.
Syllabus: General introduction about work safety in various fields, performance and human error, work safety management program, human reliability assessment, risk management (for human/ worker), work safety management engineering in various work fields. Basic Safety, OSHA Standards, hazard identification and elimination, accident causes and prevention, hazard communication, safe work practice and description, function, and scope of safety engineering and management that are relevant with industry, especially that are related to safe production facility design and operation.
Prerequisite(s): -
Textbook(s):
1. Brauer. (2006). Safety and Health for Engineers, 2nd edition, John Wiley & Sons, Inc.
2. Thompson, Dan Hopwood., Workplace Safety : a Guide for Small and Midsized Companies, John Wiley &

Sons, Inc., 2006
3. A. Ian Glendonet. al, Human Safety and Risk Management,CRC Press, 2006
4. George A. Peters, Barbara J. Peters, Human Error Causes and Control, CRC Press, 2006

MACRO ERGONOMICS (3 CREDITS)
Learning Objective(s): Course participants are able to understand comprehensively about work system design that consists of interacting variables such as hardware and software within internal and external physical environment, organization structure and process in order to make it better. Ability to understand how to implement ergonomic science.
Syllabus: Introduction to macroergonomics, method and tools that are used in work system design and analysis, introduction to organization integration in productivity, safety, health and quality of work life context
Pre-requisite(s): -
Text Book(s):
1. Hendrick, W.H,. Kleiner, Brian, (2002). Macroergonomics: Theory, Methods, and Applications (Human Factors and Ergonomics)
2. Stanton, N,. Hedge, A, (2005). Handbook of Human Factors and Ergonomics Methods, CRC Press LLC.

KNOWLEDGE MANAGEMENT (3 SKS)
Learning Objective(s): Course participants are able to comprehend the concept of knowledge starting from creation, use, transfer, retention and disposal of knowledge to broaden the understanding about the importance of KM for achieving organizations objective.
Syllabus: Introduction to KM, Definition and Concept of KM, SECI Model, Information Management Body of Knowledge (IMBOK), Capitalization of Knowledge, Learning Organization, Implementation of KM in Organization , KM and Innovation, Knowledge Transfer and Open Innovation, Best Practices of KM Implementation.
Pre-requisite(s): -
Textbook(s):
1. Nonaka I., Takeuchi H. The Knowledge Creating Company: How Japanese Companies Create The Dynamics of Innovation, 1995.
2. Ackermann, M.S. etal. Sharing Expertise: Beyond Knowledge Management, MIT Press, 2003
3. Amrit Tiwana, The Knowledge Management Toolkit: Practical Techniques for Building A Knowledge Management System, Prentice-Hall, New Jersey, 2000.
4. Madanmohan Rao, Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions, Elsevier Inc. Oxford – UK. 2005.
5. Murray Jennex, Case Studies in Knowledge Management, Idea Group Publishing, 2005.

COGNITIVE ERGONOMICS (2 SKS)
Learning Objective(s): Course participants are able to understand about basic principles of ergonomics and human factors in cognitive perspective. Students are expected to implement knowledge of cognitive ergonomics in workplace, and also be expected to measure, evaluate, and analyze performance and behavior of various fields and the relation to technology development and engineering. Students are also are expected to design Hierarchical Task Analysis (HTA) as a part of task design based on cognitive.
Syllabus: General introduction to ergonomics and human factors, cognitive aspect in umanmachine/ machine-environment interaction, cognitive aspect in industry, cognitive aspect in transportation, information technology and cognitive performance, behavior aspect and human cognitive performance in designing Hierarchical Task Analysis (HTA).
Text book(s):
1. Harris, Engineering Psychology and Cognitive Ergonomics,Springer, 2011
2. Erik Hollnagel, Handbook of Coqnitive Task Design,Lawrence Erlbaum Associates Publisher, 2003, New Jersey London
3. Candida Castro, Human factors of visual and cognitive performance in driving, CRC Press, 2009

TECHNOPRENEURSHIP (2SKS)
Learning Objective(s): Course participants are able to understand concept, method and application of technopreneurship.
Syllabus: Basic Principles of Entrepreneurship, Technology for Entrepreneur, Entrepreneurship and Innovation

Text book(s):

1. Trott, P. Managing Technology Entrepreneurship and Innovation, Routledge, Uk, 2014

HUMAN PERFORMANCE ENGINEERING (2SKS)

Learning Objective(s): Course participants are able to understand basic concept and implement the knowledge of human performance engineering. Participants should be able to calculate, evaluate and analyse performance and behaviour in real cases which also includes the advancement in technology and engineering,

Syllabus: Introduction to human performance engineering, tools and methods used in human performance engineering, human performance in usability engineering and product design.

Text book(s):

1. Bailey, R.W. Human Performance Engineering, Prentice Hall, 1982.
2. Jurnal dan artikel terkait HPE.

MANUFACTURING SYSTEM (3 SKS)

Learning Objective(s): Course participants are able to understand manufacturing system concept that converts raw material into valuable products and its implementation, including product design activities, process and facilities, and technology used to create competitive products.

Syllabus: Introduction to Manufacturing System. Processes. Manufacturing Facility & Technology. Product Design & Development. Green Manufacturing. Resource planning & ERP. Simulation. Introduction to Plant Simulation for Manufacturing System. JIT & Lean Production. Value Stream Mapping. Optimization Model and its application in production. Case study.

Prerequisite(s): -

Textbooks:

1. Operations Management-An Asian Perspective; William J. Stevenson, and Sum Chee Chuong ; McGraw-Hill; 2010
2. Manufacturing Planning and Control for Supply Chain Management; F. Robert Jacobs, William Berry, D. Clay Whybark, and Thomas Vollmann; McGraw-Hill; 2011.
3. The Fundamentals of Production Planning and Control; Stephen N. Chapman; Pearson - Prentice Hall, 2006.

TOTAL QUALITY MANAGEMENT (2 SKS)

Learning Objective(s): Course participants are able to use concepts and application of TQM as the basis for analysis and evaluation of quality improvement system.

Syllabus: TQM Studies vs Principles. MBNQA. Statistical QC. Cost of Quality. Organizing for Quality. QFD. Capability Process. Six Sigma.

Text Book(s):

1. Rao, et al. TQM : A Cross Functional Perspective, Prentice Hall.
2. Quality Management; Goetsch & Davis, 2000, Prentice Hall

SUPPLY CHAIN MANAGEMENT (2SKS)

Learning Objective(s): Course participants are able to understand about concept and application of SCM to analyze and evaluate the role of operators in a whole supply chain

Syllabus: Introduction to SCM, Strategy and Planning, Enterprise Resource Planning, Purchasing, Transportation Method, Shortest Path, Traveling Salesman Problem, Vehicle Routing Problem, warehousing management, reverse logistics, location theory, network planning process, SCM development

Prerequisite:-

Text Book(s):

1. Novack, R.A., Supply Chain Management: A Logistics Perspectives, 2008.

DATA MINING (3SKS)

Learning Objective(s): Course participants are able to organize the extraction, process, and data analysis in a right way to make decisions.

Syllabus: Concept and Process of Data Mining, Algorithm in Data Mining, Data Mining Application in Organization.

Pre-requisite(s): -

Text Book(s):

1. Nisbet, R. (2009). Handbook of Statistical Analysis and Data Mining Applications, Elsevier.

MULTIVARIATE ANALYSIS (3SKS)
Learning Objective(s): Course participants are able to organize the extraction, process & analysis of multivariate data in a right way to make decisions.
Syllabus: of Basic Statistical Concepts, Multiple Regression. Manova. Principal Component Analysis. Factor Analysis. Cluster Analysis. Discriminant Analysis. Logit Analysis. Canonical Correlation. Multidimensional Scaling. Structural Equation Modeling.
Pre-requisite(s): -
Text Book(s):

1. Hair,J.F.,B. Black, B. Babin, and R.E. Anderson (2005) Multivariate Data Analysis, Sixth Edition, Prentice Hall.
2. Richard Johnson and Winchern (1998) Applied Multivariate Statistical Analysis, Fourth Edition, rentice Hall.
3. W.R. Dillon and M. Goldstein (1984) Multivariate Analysis: Methods and Applications, John Wiley & Sons.

DECISION UNCERTAINTIES AND RISK (2SKS)
Learning objective(s): Course participants are able to analyze risks and uncertainties based on statistical tools accurately to make decision
Syllabus: Concept and Decision Making Process, Uncertainty Theory, Risks Analysis Prerequisites: Statistics and Probability, Industrial Statistics
Prerequisite(s): -
Text books:

1. Parmigiani, G. (2009). Decision Theory: Principles and Approaches , John Wiley.

CUSTOMER RELATIONSHIP MANAGEMENT (2SKS)
Learning Objective(s): Course participants are able to understand the role and function of customer relationship management in improving organization's/company's competitiveness.
Syllabus: Concept and Procedure of CRM Implementation in Organization, CRM Process Management, Managing Networks for CRM performance CRM Success Measurement, Best Practices of CRM Implementation, Managing supplier partner relationships, IT for CRM
Pre-requisite(s): -
Textbooks:

1. Peppers, D. (2011). Managing Customer Relationships: A Strategic Framework, John Wiley & Sons.
2. Francis Buttle (2009). Customer Relationship Management, Elsevier.

ADVANCED OPTIMIZATION (2SKS)
Learning Objective(s): Course participants are able to design and implement various heuristic and meta-heuristic optimization algorithms to solve problems in industrial engineering field.
Syllabus: Introduction to Optimization. Complexity Theory. Basics of Heuristic. Hill Climbing Algorithm. Greedy Algorithm, Simulated Annealing, Tabu Search, Genetic Algorithm, Challenge Counter Techniques , Multi-destinations metaheuristic.
Pre-requisite(s): -
Text Book(s):

1. Zbigniew Michalewicz,. David B. Fogel (2004). How to Solve It: Modern Heuristics, Springer.
2. Essentials of Metaheuristics, Sean Luke (2009). Essentials of Metaheuristics, Lulu, available at http://cs.gmu. edu/▫sean/book/metaheuristics/
3. Andries P. Engelbrecht (2007) Computational Intelligence, An introduction, John Wiley & Sons, England.

SYSTEM ENGINEERING MANAGEMENT (3SKS)
Learning Objective(s): Course participants understand the basics of system engineering management in the industry so they would be able to manage a process of design, installation, management and termination of a system
Syllabus: The concept and methodology of systems engineering, Life Cycle Systems: Concepts, Development, Production, Use and Support, and End Systems. Processes in Life Cycle System: Technical Process, Projects Process, Organization Processes and Acquisition Process of Goods or Services. SEMP- Systems Engineering Management Plan, Systems Engineering Organization, Systems Engineering Evaluation Program. CMMI-Capability Maturity Model Integration. Outsourcing Concept.

Text Book(s):

1. System Engineering Management, 3rd Edition, Benjamin S. Blanchard, John Wiley & Sons. Hoboken – New Jersey. 2004
2. Cecilia Haskins, CSEP, Kevin Forsberg, CSEP and Michael Krueger, CSEP. SYSTEMS ENGINEERING HANDBOOK: A GUIDE FOR SYSTEM LIFE CYCLE PROCESSES AND ACTIVITIES, version 3.1, 2007
3. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

SYSTEM PERFORMANCE ANALYSIS AND MODELLING (3SKS)

Learning Objective(s): Course participants are able to specify, predict and evaluate the performance of the system designed by different system modeling

Syllabus: Micro-level performance modelling (Financial Modelling). Business Process Modelling, Macro-level performance modelling with dynamic systems approach.

Text Book(s):

1. Cecilia Haskins, CSEP, Kevin Forsberg, CSEP and Michael Krueger, CSEP. SYSTEMS ENGINEERING HANDBOOK: A GUIDE FOR SYSTEM LIFE CYCLE PROCESSES AND ACTIVITIES, version 3.1, 2007
2. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

TECHNOLOGY POLICY MODELING USING SYSTEM DYNAMICS (2SKS)

Learning Objective(s): Course participants understand the concepts, methods and tools for systems dynamics modelling to specify, predict and evaluate the impact of a policy so a better policy decision could be formulated.

Syllabus: Introduction to Policy and Technology Policy, Technology aspects of policy, Introduction to system dynamics, basic models of policy analysis using system dynamics, policy modelling case studies.

Text Book(s):

1. Model Pengenalan Pemodelan Sistem Dinamis SEMS
2. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

CONCEPTUAL SYSTEM DESIGN (2SKS)

Learning Objective(s): Course participants understand the concepts, methods and tools to develop a complete system based on the needs of multiple stakeholders, which could be transformed into a system with complete specifications.

Syllabus: Volere User Requirements Methodology, Design for Manufacturing, Design for Six Sigma, Design for Reliability, Maintainability, and Supportability, Use Case Modelling, Systems Architecting, Systems Specification, Design Structure Matrix (DSM)

Text Book(s):

1. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

GAME THEORY (2SKS)

Learning Objective(s): Course participants are able to know how to make decisions in a condition that involves multi-actor. Course participants are able to calculate the effects of strategic decisions or policy taken in an environment and take into account the response of that decision.

Syllabus: Types of strategic games, Nash equilibrium, Continuous and Discontinues Games, Evaluation and Learning in the game, Games with a non-perfect information, Nash bargaining action, repeated games, mechanism design, social choice and voting theory

Text Book(s):

1. Gibbons, R., Game Theory for Applied Economists, Princeton University Press, 1992. (Hereafter G)
2. Binmore, K., Game Theory: A Very short Introduction, Oxford University Press, 2007
3. Auman, R.J., Handbook of Game Theory with Economics Application, North-Holland Press, 2002

RESOURCE AND LOGISTIC SUPPORT FOR SYSTEM ENGINEERING (2SKS)

Learning Objective(s): Course participants understand the tools and methods of planning and managing of resources and logistical support in systems engineering process.

Syllabus: Outsourcing Principles and Methods, Acquisition and Supply, Logistics Planning, Principles of Supply Chain Management System, Scheduling and Sourcing for System Engineering.

Text Book(s):

1. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

THESIS (8 SKS)
Learning Objective(s): Course participants are able to systematically present his/her problems and idea during scientific forum with concise and correct.
Pre-requisite(s): Please Read Thesis SOP
Text Book(s):

1. Manual Penyusunan Tesis Universitas Indonesia dan Departemen Teknik Industri, 2008.