SILABUS MATA KULIAH WAJIB

SILABUS KURIKULUM

SUBJECT	**TI141201**	**: INTRODUCTION TO ECONOMICS**
	Kredit	: 2 sks
	Semester	: 1

DESCRIPTION OF SUBJECT	
Introduction to Economic is not to introduce to Economics but is to draw important part from it for engineering design in industrial engineering perspective. The important part of economic that will be drawn include some topics of micro and macro- economics that have strong relevancy with importance for design, development, and installation of integrated system of part or product industrial business that gain economic profit sustainability.	
LEARNING OBJECTIVE IE STUDY THAT BE SUPPORTED	
1.1.1	Able to identify, formulate, and analyze complex engineering problems on integrated system (include : man, material, equipment, energy, and information) in services or manufacturing industry base on engineering judgment and principles.
1.1.3	Able to formulate solution to solve complex problems on integrated system in services or manufacturing with care to factors of economy, public health and safety, cultural, social, and physical environment.
4.1.1	Able to self manage and have a professional attitude in work place.
LEARNING OBJECTIVE OF SUBJECT	
Student able to understand principles of economics (micro and macro) for design, development, and installation optimal integrated system of parts of transformation	

process in level of work station, enterprise, and industry.

OUTLINES OF SUBJECT

1. Economic Problems and Concepts
2. Demand and Supply
3. Elasticity of Demand and Supply
4. Firm Cost Structure
5. Market Structure
6. Demand and Supply of Production Factor
7. Capital, Investment, and Innovation Technology
8. Problems and Macro Economic Measurement
9. Money and Monetary Institutions
10. Payment Balance and Exchange Value
11. Inflation
12. Growth and Sustainability Economy

PREREQUISITE

-

MAIN REFERENCE

Lipsey, R, Crystal, A, 2011, Economics, 12 th, Oxford University Press Inc., New York.

SUPPORTED REFERENCE

-

COURSE	**TI141202 : ENGINEERING DRAWING**
	Credits : 2 credits
	Semester : 1

COURSE DESCRIPTION

Engineering Drawing is one of the important activity in manufacturing system, which engineer tranform their design or ideas into product visualization. This course provides knowledge about engineering tools, how to read and understand an engineering drawing, also some basic principles of engineering drawing that used to produce and develop tangible products.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.

COURSE'S LEARNING OUTCOME

Students able to read an engineering drawing, and able to make visual design of products that is good and communicative.

MAIN TOPICS

1. Introduction to Engineering Drawing.
2. Information gathering.

3. Sketching with drawing equipments.
4. Projections.
5. Dimensioning.
6. Sectioning.
7. Tolerances.
8. Surface texture.
9. Welding drawing.
10. Supporting part indication.
11. Piping and electronic drawing.

PREREQUISITE

-

MAIN REFERENCES

Gupta, BVR and M Raja Roy. Engineering Drawing. New Delhi: I.K. International Publishing House Pvt Ltd. 2008

SUPPORTING REFERENCES

Groover, Mikell P and E.W, JR., CAD/CAM : Computer Aided Design and Manufacturing, Prentice Hall, 1987.

Jensen, C.H., and Helsaed, Fundamentals of Engineering Drawing, Mac Graw Hill Co., 1987.

Luzadder, Waren J., Fundamentals of Engineering Drawing (With an Introduction to Interactive Computer Graphic for Design and Production), 9th edition, Prentice Hall, 1986.

Sato, Takeshi G., dan N. Sugiharso H., Menggambar Mesin Menurut Standar ISO, Pradnya Paramitha, 1996

COURSE	**TI141204 : ALGORITHMS AND PROGRAMMING**
	Credits : 3 credits
	Semester : 2

COURSE DESCRIPTION

Teach and discuss how to solve problems using algorithms, build algorithm and then implementing using programming language

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

understand how to build algorithms , solving problem using algorithms and how to implement the algorithms through high level programming language (C,C++, VB)

COURSE'S LEARNING OUTCOME

•

MAIN TOPICS

- Algorithms and Flowchart
- Tipes of data
- Repeat structure /loop While-Do, Repeat-Until and For,
- Making condition using IF and CASE

- Procedure
- Function
- Array
- *Divide & Conquer Techniques*
- *Recursion*
- *Implementation for optimization techniques : steepest descent, newton method*

PREREQUISITE

-

MAIN REFERENCES

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithm", The MIT Press, Cambridge, Massachusetts London, England

SUPPORTING REFERENCES

Rinaldi Munir, *"Algoritma dan Teknik Pemrograman"*, Andi Yogyakarta

COURSE	**TI141207**	**: COST ANALYSIS**
	Kredit	: 2 sks
	Semester	: 3

COURSE DESCRIPTION

Students are expected to have a thorough understanding on accumulated cost during various types of manufacture and service industry and able to perform an estimation and calculation of production cost, record it according a generally accepted accounting system and review it based on report produced.

DEPARTMENT'S SUPPORTING LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering,

	methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.

COURSE LEARNING OUTCOME

- To understand the relationship of industrial activities cycle and accounting process.
- To provide knowledge and skills in recording, classifying, reporting and analysis of financial report.
- To understand cost management systems in varios type of industry.
- To identify and calculate various product cost type.
- To understand job order osting, process-costing and activity based costing.
- To understand full costing dan direct costing methods.
- To understand product cost estimation.
- To understand profit planning and control system.

MAIN TOPIC

Industrial activities cycle and accounting process, Financial Transactions, Adjustment entries, Accounting cycle and solution, Accounting system, Inventory calculation and assestments, cost concepts and behaviour, Job order costing, Process costing, Activity based costing, Activity based management, Cost estimation, Profit planning and control.

PREREQUISITE

PTSI

MAIN REFERENCES

Warren et al., Accounting 21th , Thomson Learning, 2010.

SUPPORTING REFERENCES

Hilton, Managerial Accounting: Creating Value in a Dynamic Business Environment, 9/e, Mc Graw Hill, 2011.

MATA KULIAH	**TI141208**	**: OPTIMIZATION MATHEMATICS**
	Kredit	: 3 sks
	Semester	: 3

COURSE DESCRIPTION

The course provides students with basic techniques of linear algebra, including topics related to vectors, matrices, vector spaces and subspaces, and linear transformations. It

critically reviews mathematical reasoning, proofs, and abstract structures.	
DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics
2.1.2	To comprehend basic engineering to support industrial engineering knowledge
2.1.3	To comprehend basic management and economics
2.2.1	To comprehend in detail industrial engineering knowledge
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
LEARNING OUTCOME	
Students are able to do basic matrix and vector operation, solve linear equation systems, understand the concepts of eigen, linear combination, decomposition and linear transformation	
MAIN TOPIC	
1. Matrix and its Operations : types of matrix, matrix Operations, Matrix Invers, 2. Linear equation system: elementer row operations , homogen linear equation system, matrix determinant 3. Solving linear equation system using Crammer method, vector space: n Euclidean Space, general vector space , vector sub space, linearly independent vector, Basis and Dimension 4. Gram-Schmidt Process, QR Decomposition , dot product , norm of vector, distance between vector, angle between vectors, Basis orthonormal, Basis change, Eigen space: Eigen value, Diagonalization, orthogonal diagonalization, linear Transformation : Kernel and range, matrix transformation.	
PREREQUISITE	
calculus 1 , calculus 2	
MAIN REFERENCE	
Anton H., Elementary Linear Algebra 9th Edition, Wiley	
SUPPORTING REFERENCE	
Linear Algebra Jim Hefferon, Ebook.	

COURSE	TI141209 : INDUSTRIAL AUTOMATION
	Credit : 3 credits
	Semester : 3

COURSE DESCRIPTION

A modern industry always develop not only its technology, but also human resources. In this globalization, both manufacturing and service industries have to make some innovations in term of the use of technology, starting from manual process happened in the past, to fully automated system. An engineers as its human resources should have the ability to operate automated tools and equipment, moreover they are able to design an aoutomated system especially in shop floor. This course provides an understanding about automation functions and implementation for industries.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body

COURSE'S LEARNING OUTCOME

Students are able to identify the need of technical and non technical aspects, analyze and make an improvement automation design for industries.

MAIN TOPICS

1. Automation for industries.
2. Automation logic.
3. Automation components (sensor, actuator, and other system components).
4. Industrial control system.
5. Electronics and microprocessor.
6. Discrete control using PLC.
7. Computer, NC and CNC.
8. Industrial robotics.
9. Automation design.
10. Automation application.

11. Computer integrated manufacturing.
PREREQUISITE
-
MAIN REFERENCES
Groover, MP 2001, Automation, Production Systems, and Computer – Integrated Manufacturing, 2nd edition, Prentice Hall, New Jersey
SUPPORTING REFERENCES
Soloman, S 1994, Sensors and Control Systems in Manufacturing, McGraw-Hill, New York Toncich, DJ 1993, Data Communications and Networking for Manufacturing Industries, Chrystobel Engineering, Brighton Toncich, DJ 1994, Computer Architecture and Interfacing to Mechatronic Systems, Chrystobel Engineering, Brighton http://oeiwcs.omron.com/ http://www.autodev.com/ADI_Catalog/I1.htm http://www.roboticsonline.com; http://www.seikorobots.com

COURSE	**TI141210**	**: INDUSTRIAL ECOLOGY**
	Credit	: 2 credits
	Semester	: 4

COURSE DESCRIPTION	
This course provides an understanding about interrelation among human activities, industries, technological aspect, social system and natural resources. So that students have the important role and function to keep environment sustainability, able to adapt and give a solution consider to environmental aspect for any kind of industrial activities.	
CAPAIAN PEMBELAJARAN PRODI YANG DIDUKUNG	
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
4.3.1	To be sensitive to environmental and sustainability issues and to accommodate those issues in analysis, design, and decision making.
COURSE LEARNING OUTCOME	

Students understand about intterelation among human activities, waste and environment impacts. Also understand about sustainable design consider to environment aspect.
MAIN TOPIC
Environment system concept, energy, natural resource and development, environmet waste, green industry, eco industrial park concept.
PREREQUISITE
-
MAIN REFERENCES
Miller.G.T. (2004).Living in the Environment Principles, Connections and Solution.13th, Thomson Learning.
SUPPORTING REFERENCES
Kristanto, P. (2012). EkologiIndustri. PenerbitAndi. Jogjakarta. Allenby, B., Graedel TE. (1993). Industrial Ecology, Prentice Hall. New York.

COURSE NAME	**TI141212**	**: ORGANIZATIONAL AND HUMAN RESOURCE MANAGEMENT (OHRM)**
	Kredit	: 3 sks
	Semester	: 6

COURSE DESCRIPTION
Human Resource Management needs to be tailored to the organization's strategic choice of design. While the design of the organization must be aligned with the strategy of the company or organization. Organizational and Human Resoureces Management (OHRM) course more emphasis on organizational strategy, organizational design and management of human resource management from recruitment to development of human resources. Through OHRM course students are expected to have an understanding and be able to manage human resources efficiently and effectively.
DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	Able to identify, formulate and analyze complex engineering problems in an integrated system (including human, material, equipment, energy, and information) both in the service industry or manufacturing, based on considerations and engineering principles
1.1.2	Able to investigate and provide a valid conclusion to the problems of complex integrated systems in the service industry or manufacturing use basic engineering principles and to carry out research (analysis, data interpretation and synthesis of information)
1.1.5	Being able to choose and implement resource "design tools and engineering analysis" according to the latest systems engineering activities by considering the limitations
2.1.1	Mastering basic quantitative sciences, especially mathematics and statistics

2.1.2	Mastering the basics of engineering science that supports understanding of the industry
2.1.3	Mastering the basics of management science and economics
2.2.1	Mastering in depth field of industrial engineering
2.2.2	Mastering the theory of system (include: analysis, design, dynamics, engineering, methodology and control systems) and recent engineering applications of mathematics
3.1.1	Can work together in cross-functional and cross-organizational business or organization in a network of supply chain
3.1.2	Able to plan, execute, and exercise control over the plan at the situation with the limited resources available
3.2.1	Being able to make decisions or give guidance in making the right decisions based on the data / information
3.2.2	Could report on the work group to be used as information for higher organizational hierarchy or for other stakeholders

LEARNING OUTCOME

- Students are able to explain the relationship between strategy , organizational design and human resource management
- Students are able to create a draft vision and mission statement
- Students are able to draw conclusions about the characteristics of a good vision and mission
- Students are able to choose an appropriate generic strategy (product leadership , excellent operational , customer intimacy)
- Students are able to explain the definition of authority (vertical and horizontal differentiation) and control (span of control)
- Students are able to mention the types of organizational structure and the advantages / shortcomings masing2
- Students are able to design in accordance with the organization 's business strategy of an organization
- Students are able to design human resource management strategies derived from the organization's strategy
- Students are able to explain the 8 main pillar in HRM
- Students are able to do a simple job analysis
- Students are able to explain a variety of employee performance appraisal tools
- Students can design a compensation system according to organizational design and business strategy

SUBJECT REVIEW

The relationship between MOSDM with Keteknikindustrian, Organizational Strategy, Types of organizational strategy, organizational structure, Design Choices Organizational Structure, organizational design alignment with organizational strategy, Human Resource Management, Human Resources Management alignment with organizational design,

Human Resource Development, Assessment performance, Industrial Relations and the rules and regulations relevant perudang, Conflict Management
PREREQUISITE
-
MAIN REFERENCES
1. Dessler, Gary. Human Resource Management, 13th ed. Pearson Prentice Hall: 2013 2. Jones, Gareth R. Organizational Theory, design, and Change, 7th ed. Prentice Hall: 2013
SUPPORTING LITERATURE
1. Armstrong, Michael. Armstrong's Handbook Of Human Resource Management Practice, 11th Edition. Kogan Page: 2009. 2. Brian E. Becker, Mark A. Huselid, Dave Ulrich, "The HR Scorecard Mengaitkan Manusia, Strategi dan Kinerja", Translation copyright Erlangga, 2009

COURSE	**TI141301 : INTRODUCTION TO INDUSTRIAL AND SYSTEM ENGINEERING**
	Credit : 2 sks
	Semester : 1

COURSE'S DESCRIPTION
An overview of the profile, profession, employment opportunities and competencies that would be possessed by a graduate of Industrial Engineering is initial foundation that need to be understood by industrial engineering students. Introduction to Industrial and Systems Engineering gives that overview both hard skill and soft skill, an initial understanding of a system and their interactions, understanding of business systems and business processes occurring within the company in general and the way it is managed, the interaction between the company, as well as an overview of the curriculum and courses that exist in the Industrial Engineering Department. After attending this course, students are expected to understand and be able to explain the basic framework of science in Industrial Engineering, to understand the concept of the system and their interactions, as well as understanding the structure and linkage of Industrial Engineering courses. This course will introduce a variety of teaching methods based on Student-Centered-Learning (SCL) that student actively involved in learning process.
COURSE'S LEARNING OUTCOME SUPPORTED DEPARTMENT

1.1.3	Be able to formulate a solution to a complex problem solving in both the integrated system service or manufacturing industry, with attention to economic factors, health and public safety, cultural, social and environmental (environmental consideration).
4.1.3	Be able to communicate ideas systematically both orally and in writing in English and in Bahasa Indonesia

COURSE'S LEARNING OUTCOME

1. Students understand and are able to explain the basic framework of science in Industrial Engineering
2. Students understand and are able to explain the definition of system and its content
3. Students understand, own and are able to explain the systems thinking
4. Students have the basic analytical ability in understanding systems and simple business processes
5. Students understand the curriculum structure and interrelationships between the courses
6. Students have team working ability to do simple assignments
7. Students have basic learning skills include searching, reading, extracting, and presenting information and ideas orally and in writing

MAIN TOPICS

1. Profile, profession, employment opportunities and competencies of Industrial Engineering
2. Introduction to system
3. Introduction to system modelling
4. CIMOSA Business model
5. Business processes within an enterprise
6. Macro interaction within an enterprise
7. Manage Process: Set Direction, Set Strategy, Direct Business
8. Core Process: Develop Product/Service, Get Order, Fulfil Order, Product Support
9. Support Process: Human Resources Development, Finance/Accounting, Information Technology, Maintenance
10. Curriculum structure of Industrial Engineering and interrelation of the courses

PREREQUISITES

-

MAIN REFERENCE

-

SUPPROTED REFERENCES

1. Wignjosoebroto, S. (2003) *Pengantar Teknik dan Manajemen Industri*, Guna Widya, Surabaya.
2. Turner, W. (1993) *Introduction to Industrial and System Engineering*, Prentice Hall, New York.
3. Hicks, P. E. (1994) *Industrial Engineering and Management: A New Perspective*, McGraw-Hill, Tokyo.
4. Daellenbach, H. G. & McNickle, D. C. (2005) *Management Science: Decision Making through Systems Thinking*, Palgrave Macmillan, New York

Course	**TI141302**	**: INDUSTRIAL STATISTICS I**
	Credit	: 3 sks
	Semester	: 2

COURSE DESCRIPTION

Industrial statistics 1 discusses statistical methods that can be used to solve industrial problems. Topics covered include types of data, descriptive statistics (numeric and graphic), probability distribution (discrete and continuous), sampling distributions, sampling methods, parameter estimation and confidence interval.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE'S LEARNING OUTCOME

- able to use descriptive statistics to analyze data
- able to use some inferential statistics methods (probability distribution,sampling, point estimate and confidence interval) to solve industrial problem
- Able to use statistical software.

MAIN TOPICS

1. Introduction to industrial statistics
2. Descriptive Statistics
    a. Data type
    b. Method of data collection
    c. Measures of central tendency and variability
    d. Graphical methods for describing data.
3. Inferential Statistics
    a. Probability theory
    b. Discrete Probability Distribution
    c. Continous probability distribution

d. Sampling Method e. Sampling distributions f. Point estimation of parameters g. Confidence Interval.
PREREQUISITE
-
MAIN REFERENCE
David F. Groebner, Patrick W. Shannon, Phillip C.Fry dan Kent D. Smith, "Bussiness Statistics : A Decission Making Approach", Prentice Hall, 8th Edition,2010.
SUPPORTING REFERENCES
Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probabilitiy and Statistics for Engineers and Scientists", Pearson Prentice Hall, 8th edition, 2007

COURSE	**TI141303 : MANUFACTURING PROCESS**
	Credits : 3 credits
	Semester : 3

COURSE DESCRIPTION
Manufacturing is a process to make a product from raw material through production activities involving technologies. An Industrial Engineer has to understand manufacturing process that common used in industries, analyze the process, and design an improvement for existing condition. This course provides an understanding about manufacturing processes especially to produce discrete part and product components, also design for manufacture for getting better process to increase process efficiency and high productivity.

CAPAIAN PEMBELAJARAN PRODI YANG DIDUKUNG	
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
4.1.1	Mampu mengelola diri dan bersikap professional dalam lingkungan kerja
4.2.1	Kemampuan bekerjasama dalam tim secara proporsional sesuai dengan tuntutan

	pekerjaan

COURSE'S LEARNING OUTCOME

Students understand basic principles of manufacturing and production process both traditional and modern technologies. Moreover students are able to analyze process and technical aspects through transforming product design into finished good.

MAIN TOPICS

1. Introduction to manufacturing process.
2. Metal casting.
3. Casting processes.
4. Formation and deformation.
5. Sheet metalworking.
6. Powder metallurgy.
7. Plastics.
8. Maching principles.
9. Time machining and Selection Process.
10. Machining tools and equipment design.
11. Non Traditional Machining (NTM).
12. Joining and fastening process.
13. Advanced Manufacturing Technology.

PREREQUISITE

-

MAIN REFERENCES

Groover, M.P. (2002). *Fundamentals of Modern Manufacturing*, Prentice Hall

SUPPORTING REFERENCES

Kalpakjan, Seroke (1995). *Manufacturing Engineering and Technology*, 3rd edition, Addison-Wesley Pub. Company.

Schey, John A. (1987). *Introduction to Manufacturing Process*, 2nd edition, Mc Graw-Hill Book Co.

De Garmo, E. P.D. (1979), *Material and Processes in Manucturing*, New York, Collier Mc Millan Publ.

Pandey, PC. (1983), *Modern Manufacturing Processes***,** Second Edition, Tata Mc. Graw Hill Publishing Company Ltd.

Geough, JA. (1988), *Advanced Methods of Machining*, First Edition, Chapman and Hall Ltd.

Gershwin, Stanley B. (1994), *Manufacturing Systems Engineering* , Prentice Hall.

Schey, John A. (1987), *Introduction to manufacturing Processes* Second Edition, Mc Graw-Hill Book Co.

Manufacturing Process Handouts

www.matweb.com

COURSE	TI141304 : INDUSTRIAL STATISTICS II

	Credit	: 3 units
	Semester	: 3

COURSE DESCRIPTION

Data analysis is absolutely needed to solve industrial problems. To give solution to this problem, students need strong analytical skill. Industrial Statistics I and II give understanding and set up comprehensive ability to fulfill this need. Industrial Statistics II is a continuation of its predecessor Industrial Statistics I. Industrial Statistics II mainly emphasizes on comprehending inferential statistics including hypothesis test, analysis of variance, correlation analysis, regression analysis, goodness of fit, contingency table and non-parametric statistics. By mastering these topics, students are expected to have sufficient knowledge and strong analytical skill especially in inferential process (how to estimate population parameter based on sample data) in the shake of completing their further courses, on job training, or undergraduate thesis.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE'S LEARNING OUTCOME

Able to apply inferential statistics based on hypothesis test, analysis of variance, regression, and non-parametric statistics norms.

MAIN TOPICS

1. Introduction to Industrial Statistics II and review of Industrial Statistics I
2. Hypothesis test
3. Analysis of variance
4. Correlation analysis
5. Regression model and analysis for single variable

6. Multivariable regression 7. Goodness of Fit Test 8. Contingency table (cross tabulation analysis) 9. Non-parametric statistics.
PREREQUISITE
Industrial Statistics I
MAIN REFERENCE
David F. Groebner, Patrick W. Shannon, Phillip C.Fry dan Kent D. Smith, "Bussiness Statistics : A Decission Making Approach", Prentice Hall, 8th Edition,2010.
SUPPORTING REFERENCES
Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probabilitiy and Statistics for Engineers and Scientists", Pearson Prentice Hall, 8th edition, 2007.

MATA KULIAH	**TI141305 : APPLIED INDUSTRIAL ERGONOMICS**
	Kredit : 3 sks
	Semester : 3

DESCRIPTION
Industrial ergonomics aims to design the working interactions for higher industrial productivity by considering effectiveness, efficiency, safety, and comfortness. This course is designed to provide knowledge and ability for student in order to improve the processes or work equipment fit to Ergonomics principles. The object of discussion will related to improvement of human interaction quality by considering humans, machines, labor, environment, systems and organizations. Industrial ergonomics notice various human abilities, advantages and disadvantages in improving the work interaction.
DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.

2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.

LEANING OUTCOMES

- able to explain the basic concept and data of Ergonomics study
- able to analyze human body posture and working mechanism
- able to analyze the human interaction in work system
- able to analyze human abilities and limitations in avoiding the error
- able to analyze the environmental factors in work system

POKOK BAHASAN

- Introduction to industrial Ergonomics & principles
  - Industrial Ergonomics Roadmap
  - Human-Machines System
- Physical Ergonomics
  - Anthropometry
  - Biomechanics
  - Body Rythym
- Cognitif Ergonomics
  - Display dan Control Design
  - Information Ergonomics
- Environmental Factor in Ergonomic evaluation
- Work Schedule and Design Shift Work
- Laboratory activities

REQUISITE

Industrial Statistics I

MAIN REFERENCE

Tayyari, Fariborz and Smith, James L. (1997). *Occupational Ergonomics: Principles and Applications.* Chapman & Hall, London.

REFERENCES

Salvendy, G. (2012). *Handbook of Human Factors and Ergonomics, 4th edition*, John Willey and Sons. Wickens,C.D., Gordon,S,E., Liu, Y., (2003). *An introduction to human factors engineering Pearson, 2nd edition*, Pearson Ltd.
Granjean, E. (1982). *Fitting the Task to the Man: an Ergonomic Approach.*Taylor & Fabrics Ltd.

Huchingson, Dale R. (1981). *New Horizons for Human Factors in Design.*McGraw-Hill Book company.
Konz, Stephan. (1995).*Work Design: Industrial Ergonomics.* ScottsdalePublishing Horizons, Inc.
Pulat, B. Mustafa. (1992).*Fundamentals of Industrial Ergonomics.* Prentice-Hall.
Sanders, M.S. and McCormick, E.J. (1992). *Human Factors in Engineering and Design.*McGraw-Hill Inc.

COURSE	**TI141306 : ENGINEERING ECONOMICS**
	Credits : 3
	Semester : 4

DESCRIPTION

Engineering economics aims to study and analyze the economic impact of the engineering solutions or decision makings. The economic analysis includes the calculation and comparison between benefit and cost that incurred in the implementation of engineering solutions. The solution is economic valuable when the benefit is higher than its cost. The commercial and non-commercial institution will select the solution that has the best economic value. Engineering economics course will equip the student with the ability to conduct economic analysis through delivering concepts and methods in analyzing the economic value of the engineering decision.

CAPAIAN PEMBELAJARAN PRODI YANG DIDUKUNG

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

3.1.1	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body
3.1.2	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.2.1	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.2	To be able to make a decision or to give direction in decision making correctly based on data and information.

COURSE LEARNING OUTCOMES

- Students able to understand and explain the concepts of value, cost, and time value of money
- Students able to model the cash flow of engineering decisions
- Students able to understand the interest concept and use interest table and formula to calculate the economic equivalence of engineering decisions
- Students able to understand and explain the impact of inflation in the economic equivalence calculation
- Students able to understand and use the methods for calculating and comparing the economic value of engineering decisions
- Students able to conduct sensitivity and risk analysis for analyzing the impact of uncertainty to the feasibility of engineering decision
- Students able to understand the concept of depreciation and its impact to financial cash flow and calculate the depreciation cost by using the appropriate method
- Students able to understand the impact of tax rate to the financial cash flow of engineering decisions
- Students able to understand the concept of replacement analysis for engineering assets
- Students able to use software application or excel functions to calculate economic value of engineering decisions

TOPICS

- Fundamental Principle of Engineering Economics
- The Concept of Value, Cost, Cash Flow, and Time Value of Money
- The Concept of Interest
- The Economic Equivalence
- The Concept of Inflation
- The Method for Comparing the Economic Value of Engineering Decisions : NPV, ROR, Payback Period, Benefit Cost Ratio
- The Sensitivity Analysis
- The Risk Analysis
- Depreciation
- Tax
- The Replacement Analysis

PREREQUISITE

Cost Estimation and Analysis

PUSTAKA UTAMA

Engineering Economic Analysis by Donald G. Newnan, Ted G. Eschenbach and Jerome P. Lavelle (Feb 26, 2004)
PUSTAKA PENDUKUNG
Contemporary Engineering Economics (5th Edition) by Chan S. Park (Jan 13, 2010)

COURSE	**TI141307 : OPERATIONS RESEARCH 1**
	Credit : 3 credit
	Semester : 4

COURSE DESCRIPTION	
Every business and industry naturally seeks the best design and operation under scarce resource allocations. Thus, the decision making process is critical to find the best solution. This course deals on the scientific approach to decision making which involves the use of mathematical models. This course discusses the theoretical background and formulation of the mathematical models and the solution method, such as graphical method, simplex method as well as sensitivity analysis. The applications of the model in solving business and industry problems are also presented and discussed, such as transportation and network models.	
DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
COURSE LEARNING OUTCOME	
1. Students can identify the decision variables, objective function and constraints as	

mathematical models of varies business and industrial problems.
2. Students can use optimization software such as Lindo, Lingo, or GAMS for solving the mathematical model and interpret the results.

MAIN TOPIC

1. An Introduction to Model Building
2. Introduction to Linear Programming
3. The Simplex Algorithm
4. Sensitivity Analysis and Duality
5. Transportation, Assignment, and Transhipment Problems
5. Network Models

PREREQUISITE

Optimization Mathematics

MAIN REFERENCES

Wayne L Winston, "Operations Research: Applications and Algorithms", Indiana University, 4th edition, 2004

SUPPORTED REFERENCES

Mokhtar S. Bazaraa, John J. Jarvis, and Hanif D. Sherali, "Linear Programming and Network Flows", John Wiley & Sons, 2010

Course	**TI141308 : METHOD STUDY AND WORK MEASUREMENT**
	Credit : 3 sks
	Semester : 4

COURSE DESCRIPTION

"There is always a better working method" of each operation process. This principle is the basis of continuous improvement in the production floor. Increasing the process effectiveness and efficiency become the focus of improvement, which will ultimately increase productivity. The improving process begins by defining overall production system and waste identification. The waste may occurs are overproduction, inventory, transportation, motion, defect, time and process.

Method study, including motion and work study was conducted in order to get better working method and minimize waste. Motion study will study motion study arrangement to get effective and efficient working method based on human strengths and weaknesses. While time study was conducted through work measurement. Various work measurement was studied, both direct and indirect in order to be properly applied to various problems. Further analysis of work measurement result was conducted to provide recommendation for productivity improvement.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE'S LEARNING OUTCOME

- Have knowledge of various work measurement, both direct and indirect.
- Able to analyze work measurement result to provide recommendation for productivity improvement.

MAIN TOPICS

1. Production process, Productivity and Value.
2. Motion Study and Time Study for Lean Manufacturing.
3. Operation analysis and principles of motion economy.
4. Techniques of Macromotion Study.
5. Technique of Micromotion Study.
6. Predetermined Time Standards Systems (PTSS).
7. Stopwatch Time Study.
8. Work Sampling.
9. Line Balancing.
10. Standard Data.
11. Work design and analysis.
12. SMED (Single Minutes Exchange Dies)
13. Financial Compensation.

PREREQUISITE

-

MAIN REFERENCE

Barnes, M.R., *Motion and Time Study : Design and Measurement of Work*, 7th edition, New York : John Wiley and Sons, 1980.

SUPPORTING REFERENCES

1. Wignjosoebroto, S., *Ergonomi : Studi Gerak dan Waktu*, 2006, Guna Widya, Surabaya.
2. Kohnz, S.A., *Work Design*, Fourth Edition, 1979, Grid Publication.
3. Mundel, M.E., Danner, D.L., *Motion and Time Study : Improving Productivity*, 1994, Prentice Hall.
4. Relevant journal.

Course	**TI141309 : PROJECT MANAGEMENT**
	Kredit : 2 sks
	Semester : 4

COURSE DESCRIPTION

Currently, project management is getting more important. Planning, execute and controlling a project is relatively difficult due to its complexity of various aspects such as time, cost, resources, goal achievement measurement, and many more. This lecture will provide students with understanding on planning, scheduling, organizing and project control on product development projects, constructions, system information, new business and other important events. The focus will be on project's management processes and important tools use to manage a project.
The understanding on project management concepts and techniques will provide students with a competitive advantage to compete in engineering fields of work and/or other fields.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering,

	methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.

COURSE'S LEARNING OUTCOME

- To understand the main processes in project management and the importance of integration between the organizational strategy with project management .
- To understand the sub-systems in a project management system that determines the success of the project management.
- To understand the concepts and techniques detailed work breakdown structures as a basis for planning and controlling project.
- To understand the project planning and designing project control instruments.
- To understand the valuation of project.
- To understand the sources of funding available for the project and choose the best sources for engineering project.
- To understand the concepts, techniques and decision-making tools available for managing projects.
- To understand the risk factors faced by the project and choose the model of analysis, evaluation and management of project risks.
- To recognize potential conflicts and problems that can occur on the project.
- To identify critical aspects of human behavior that determine the success of the project management .
- To Use computer-based information system for managing projects effectively and efficiently .

MAIN TOPICS

1. Introduction
2. Business Strategy & Project Management
3. Project Management Organization
4. Defining a Project
5. Estimating a Project
6. Project Networks
7. Project Risk Management
8. Resource & Cost Scheduling
9. Reducing Project Time
10. Leadership
11. Team Building
12. Outsourcing

PREREQUISITE

PTSI
MAIN REFERENCE
Clifford Gray and Erik Larson, Project Management: The Managerial Process 5th, Clifford Gray and Erik Larson, McGraw-Hill, 2010.
SUPPORTING REFERENCES
Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling 11th, John Wiley, 2013.

COURSE	**TI141310 : MANUFACTURING SYSTEM**
	Credits : 4 credits
	Semester : 4

COURSE DESCRIPTION
Manufacturing system as a part of company system have to be designed and well controlled, so that the company can fulfill all customer needs, produce qualified products with short time delivery. Furthermore company has longer life time and high developed. An industrial engineer is prepared to solve real problems both in manufacturing and service industries. Manufacturing system course is designed for giving that competences to the graduates. This course aim to make students understand about the components of a manufacturing system, manufacturing operations and steps to make some improvements.
CAPAIAN PEMBELAJARAN PRODI YANG DIDUKUNG

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated

	engineering mathematics.

COURSE'S LEARNING OUTCOME

Students are able to analyze manufacturing system including manufacturing process, material handling system, inventory control, inspections, packaging and non physical activities that support manufacturing operations.

MAIN TOPICS

1. Intoduction and architecture of manufacturing system.
2. Manufacturing system planning (utility, production rate, availability).
3. Product design in manufacturing system.
4. Material handling and inventory control.
5. Automated Data Captured.
6. Assembly system.
7. Production layout (single station manufacturing cells, group technology, cellular manufacturing, flexible manufacturing system).
8. Specific concept in manufacturing system (just in time, lean production, agile, reconfigurable manufacturing system, virtual manufacturing, intelligent manufacturing system).
9. Manufacturing system planning and control (Manufacturing Planning and Control - Enterprise Resource Planning)

PREREQUISITE

Manufacturing process, Industrial automation

MAIN REFERENCES

Groover, M.P 2001, Automation, Production Systems, and Computer Integrated Manufacturing, Prentice Hall

SUPPORTING REFERENCES

Boothroyd, G 1992, Assembly Automation and Product Design, Marcel Dekker Inc., New York.

Lotter, B 1989, Manufacturing Assembly Handbook, Butterworths

COURSE	**TI141311**	**: SYSTEM MODELING**
	Credit	: 3 units
	Semester	: 5

COURSE DESCRIPTION

This course is trying to give knowledge and ability to utilize the concept of System Thinking and System Approach to deal with many practical situations in scope of Industrial Engineering and Management cases. Within studying this course, you will learn how to identify and formulate a problem, identify and set a correct objective and system relevant, utilize a correct System Diagram, and solve the problem by using a proven Management

Sciences Methodology.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
4.1.1	To be able to manage his/herself and to behave professionally in working environment.
4.2.2	To be able to communicate his/her idea systematically both oral and written in Bahasa Indonesia and English.
4.3.1	To be sensitive to environmental and sustainability issues and to accommodate those issues in analysis, design, and decision making.

COURSE'S LEARNING OUTCOME

- Provide an understanding of the basic concepts of system modeling, identification of problems, and the development of system relevant and system diagrams
- Provide an understanding the techniques of the hard systems and soft systems methodology methodology
- Ability to define problems (real and theoretical) that are relevant to the areas of industrial engineering and describe the implementation the concept of System Thinking, System Approach, and System Modeling to variety of real world and theoritical case studies.
- Provide the ability to develop models, analyze and validate the model from a system relevant

MAIN TOPICS

- System Thinking:
  - System Definition
  - System Thinking:
    - Efficiency Vs Effectiveness
    - Unplanned Outcomes and Counterintuituve Outcomes
    - Reductionist and cause-and-effect thinking
- System Concept

- Concept System, Type, and Characteristics of System
- Pervasiveness of systems
- Out-there and inside-us view of systems
- Subjectivity of system description
- System boundary and relevant environment
- Systems as 'black boxes'
- Hierarchy of systems
- System behaviour
- Feedback loops
- Control of systems

- The Problem Situation
  - The problem situation and what is a 'problem'?
  - Stakeholders or roles of people in systems
  - Problem Boundary and Scope
  - Describing Problem Situation:
    - Rich Picture Diagram
    - Mind Mapping
    - Cognitive Mapping
- System Model & Diagram
  - System models
  - Approaches for describing a relevant system
  - Essential properties of good models
  - The art of modelling
  - System Diagram:
    - Causal loop diagrams
    - Influence diagrams
    - Other system diagrams
- Hard System Methodology:
  - Exact/Optimization,
  - Heuristics,
  - Searching Methods,
  - Simulation
- Soft System Methodology
  - Soft system paradigm and working modes
  - Checkland's soft systems methodology
  - Strategic option development and analysis
  - Strategic choice approach
  - Survey of other problem structuring approaches
  - Critical systems heuristics, critical systems thinking,
- Extension System Model & Diagram:
  - Modeling Decision Problem,
  - Modeling System Safety (Reliability Block Diagram, Fault Tree Analysis, Event Tree Analysis, etc.),
  - Modeling Project/Distribution Network,
  - Financial Modeling,
  - Stochastic Modeling

o Etc.
PREREQUISITE
Operation Reseach I, Operation Research 2, and Industrial Statistics I
MAIN REFERENCE
[1] Daellenbach, H. G. and D.C. McNickle. (2005), Management Science: Decision Making through System Thinking, Pallgrave Macmillan, United Kingdom. [2] Murthy, D.N.P., Page, M.W., and Rodin,E.Y., Mathematical Modelling, Pergamon Press, 1990. [3] Clement, Robert T. (1997). Making Hard Decisions: An Introduction to Decision Analysis, 2nd Edition., Duxbury Press.
SUPPORTING REFERENCES
International and national journal reference

COURSE	**TI141312 : OPERATIONS RESEARCH 2**
	Credit : 3 credit
	Semester : 4

COURSE DESCRIPTION	
This course is the second series which gives the lecture in introduction to optimization modelling in decision making. Unlike the first series which focus on the deterministic parameters, this course also focusses on stochastic parameters and applies it on the industrial and business problems. Topics discussed are Integer Programming, Non-linear Programming, Game Theory, Dynamic Programming, Markov Chain, Queuing Theory and Montecarlo Simulation.	
DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering,

	methodology and system control) and application of up-to-dated engineering mathematics.

COURSE LEARNING OUTCOME

1. Students can explain the concepts of integer, nonlinear, dan dynamic programming, as well as game theory, markov chain, queuing theory and monte carlo simulation
2. Students can formulate those deterministic and stochastic models
3. Students can use optimization software to solve those deterministic and stochastic models and interpret the results.

MAIN TOPIC

1. Integer Programming
2. Non-linear Programming
3. Game Theory
4. Dynamic Programming
5. Markov Chain
6. Queuing Theory
7. Montecarlo Simulation

PREREQUISITE

Operations Research I

MAIN REFERENCES

Wayne L Winston, "Operations Research: Applications and Algorithms", Indiana University, 4th edition, 2004

SUPPORTED REFERENCES

Hamdy Taha, "Operations Research", USA: Macmillan Publishing Company, 7th edition, 2003

COURSE	**TI141313 : PRODUCTION PLANNING AND CONTROL**
	Credit : 4 semester credit
	Semester : 5

COURSE DESCRIPTION

Production planning and control is a central fungtion in any manufacturing company. It deals with optimizing the use of production resources in order to satisfy customers' demand. The objective of this course is to introduce to students various concepts, techniques, methods, and practical issues related to production planning and control.

DEPARTMENT'S LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.

1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.

LEARNING OUTCOME

Students are capable of understanding various methods to plan and control production as well as to solve various problems related to production planning and control.

COURSE CONTENTS

1. Introduction to production planning and control
2. The of PPC in supply chain
3. Framework of PPC
4. Demand forecasting
5. Aggregate production planning
6. Master production schedule
7. Inventory management
8. Material Requirements Planning
9. Capacity planning
10. Production activity control
11. Other relevant topics (JIT, TOC, ERP).

PREREQUISITE

Manufacturing Systems

MAIN TEXTBOOK

Fogarty, D. W., Blackstone, J. H., and Hoffmann, T. R. (1991). *Production and Inventory Management* 2nd Ed., South Western Publishing.

SUPPORTING TEXTBOOK

Arnold, J. T. (2011). Introduction To Materials Management, 5/e. Pearson Education India.

Course	TI141314 : FACILITY PLANNING
	Credit : 3
	Semester : 5

COURSE DESCRIPTION	
Facility Planning in one of the important and complex stages in enterprise strategic planning. This course will discuss several stages in facility planning i.e.: facility location analysis, material flow design, warehouse facility planning, facility layout design and framework, material handling, and planning for supporting facilities. Facility arrangement in layout and its optimization will be discussed as the main objectives of this course.	
DEPARTMENT'S LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.
LEARNING OUTCOMES	

- Able to explain the basic concept and data in facility planning
- Able to apply the location analysis method using qualitative and quantitative approaches
- Able to design the material flow and handling in plant facilities
- Able to design and evaluate the facility layout using qualitative and quantitative approaches.
- Able to specify the supporting facilities in facilities planning
- Able to model the layout in 2d and 3d presentation

OUTLINES

- Introduction of facilities design
- Location facilities determination and analysis
- Process and material flow analysis
- Production capacity determination
- Space planning and supporting facilities
- Material handling analysis
- Warehouse facility design
- Group technology dan part families
- Computer aided layout design
- Layout design using traditional and quantitative approaches
- Mathematical modeling and optimization for layout design

PREREQUISITE

Manufacturing System

MAIN REFERENCE

Wignjosoebroto,S. (1996). Tata Letak Pabrik dan Pemindahan Bahan. PT. Gunawidya

OTHER REFERENCES

Heragu, S. (2008). *Facilities Design*, 3rd edition.CRC Press, 2008

Tomkins, J., White,J., Bozer, F, Tanchoco. (1996). *Facility Planning*, John Willey & Sons, 1996

Francis, R., John W. (1992).*Facility Layout and Location, An Analytical Approach*, Prentice Hall.

Apple, J.M. (1977).*Plant Layout and Material Handling*. New York : John Willey & Sons.

COURSE	**TI141315**	**: PRODUCTS DESIGN AND DEVELOPMENT**
	Kredit	: 3 units
	Semester	: 5

COURSE DESCRIPTION

The design and development of product is a core business process for most companies. A specialized, knowledgeable and high skilled human resource is required in managing the design and development of products (P3) in order to produce a high quality product. The purpose of this course, therefore, is to provide basic theoretical and practical

understanding of customer drive product design and development process which enable student to design product which not only technically reliable, high quality, but also marketable. Product concepts, design processes, methods/techniques and current issues on product design and development are discussed, along with economic implications of design. Students will gain an understanding of product design and development processes as well as useful tools/techniques.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.1	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.
4.1.1	To be able to manage his/herself and to behave professionally in working environment.
4.1.2	To be able to work in team proportionally in accordance with working demand.

COURSE'S LEARNING OUTCOME

- Student able to explain the scope of industrial product design and development
- Student able to explain the differences between product core component and support component
- Student able to define, to synthesize, to evaluate new business opportunities of

innovative product development.

- Student able to use methods for identifying the voice of customers (VOC) and translating VOC to the final product.
- Student able to conduct product design and development process from Phase-0 to Phase-5.
- Student able to analyze and explain the trade-off between cost and quality on product specification.

MAIN TOPICS

1. Introduction of Product Design and Development,
2. Phase 0 : Product Planning,
3. Phase 1 : Concept Development,
4. Phase 2 : System Level Design,
5. Phase 3 : Detail Design,
6. Phase 4 : Product Testing and Refinement(prototyping)
7. Phase 5 : Product launching
8. Current issue on Product Design and Development

PREREQUISITE

Ergonomics

MAIN REFERENCE

Ulrich, K.T, Eppinger, S.D., *Product Design & Development*, 2nd Edition, McGraw-Hill, 2000

SUPPORTING REFERENCES

Cross, Nigel. ***Engineering Design Methods: Strategies for Product Design***. New York; John Wiley & Sons, 1996.
Roozenburg, NFM and J. Eekels. ***Product Design: Fundamentals and Methods.*** Chicester: John Wiley & Sons, 1995.

COURSE	**TI141316**	**: QUALITY CONTROL TECHNIQUES**
	Credit	: 3 credits
	Semester	: 6

COURSE DESCRIPTION

Quality control is one of important activities in manufacturing industry to make sure that the products fill the minimum requirement both from customer and producer. Quality control consist of involving entities to analyze production factors. This course provides knowledge about many techniques to produce high qualified and robust products.

DEPARTMENT'S LEARNING OUTCOME

1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)

1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.

COURSE'S LEARNING OUTCOME

Students understand and able to implement some techniques that used to control product and process quality. Moreover, students are able to analyze and design a quality assurance system.

MAIN TOPICS

1. Intoduction to Quality Control (quality concept and statistical techniques review).
2. Quality control techniques, output quality factors, output control, 7 tools applications/statistical process control tools.
3. Control chart and its application : *attributes dan variables control charts*.
4. Process utility and measurement.
5. Quality assurance system: quality system documentation, quality management system, ISO 9000, Malcolm Baldridge, *Six Sigma.*
6. Time weighted control chart, Design of Experiment, Acceptance sampling.

PREREQUISITE

-

MAIN TOPICS

Montgomery, Douglas C. (2005). *Introduction to Statistical Quality Control*. New York: John Wiley & Sons Corp.

SUPPORTING TOPICS

Grant, E.L. and R.S. Leavenworth (2000). *Statistical Quality Control*. New York: McGraw-Hill Book, Co.

Gitlow, Howards S. (1995). *Total Quality Control*. Tools and Methods for Improvement, Irwin Co. Publishing Company.

COURSE	**TI141317**	**: INDUSTRIAL SYSTEM SIMULATION**
	Credit	: 3 credit
	Semester	: 6

COURSE DESCRIPTION

Simulation is defined as a technique to imitate process/operation by using computer from a complex system which is difficult to model (cannot be modelled) as mathematical formulation. Simulation model is designed to be used for studying system by conducting experiments to achieve the desired objectives/performance measurements. This course deals on how to design the right simulation model. So that when the students have finished studied, they are able to develop valid simulation models and conduct experiments by using these models. The learning activities consist of lecturing which discusses simulation concept and simulation modelling techniques as well as assigning a real case study which will be presented at the end of the period.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE LEARNING OUTCOME

Students are able to develop valid simulation models and conduct experiments by using these models.

MAIN TOPIC

1. Introduction to simulation
2. System approach in simulation study
3. Basic simulation
4. Discrete event simulation
5. Data collection and input analysis
6. Simulation modelling with Arena
7. Verification and validation simulation models
8. Simulation Output analysis
9. System comparation

PREREQUISITE

Industrial Statistics and Operations Research II

MAIN REFERENCES

- Kelton, W., Sadowski, R., and Swets, N., Simulation with Arena, , 5th edition, McGraw-Hill Education, 2009
- Harrell, Ghosh, Bowden, *Simulation Using Promodel*, McGrawHill, 2004

SUPPORTED REFERENCES

Law, Averill.M., *Simulation Modeling and Analysis*, 4th edition, McGraw-Hill Education, 2007

COURSE	TI141318 : LOGISTICS MANAGEMENT
	Credit : 3 credit
	Semester : 6

COURSE DESCRIPTION

This subject is a mandatory course discussing logistics functions for individual companies or supply chains. The purpose of this course is to give knowledge and skills for students to understand the concepts and models in logistics management and their application in real cases. Students should also be able to use related logistics application softwares. Combining the ability to understand cases of logistics, to translate them into models and to select and determine the solution methods, students are expected to have comprehensive knowledge on logistics management.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
4.2.2	To be able to communicate his/her idea systematically both oral and written in Bahasa Indonesia and English.

COURSE LEARNING OUTCOME

- Students are able to explain scope, main functions and main functions of Logistics Management, including the role of ICT logistics
- Students are able to understand the logistics management models including Network Distribution, Transportation, and Warehousing Models. Students are able to implement the models using related softwares
- Students are able to perform an analysis of the application of logistics management to deal with the real situation

MAIN TOPIC

1. Introduction to Logistics Management,
2. Logistics Strategy,
3. Product Characteristics and Logistics,
4. Customer Service and Logistics,
5. ICT in logistics,
6. Fundamentals of Distribution Network Planning,
7. Facility Location Decisions in a Distribution Network,

8. Fundamentals of Logistics Transportation Planning, 9. Transportation Logistics Decisions, 10. Warehousing and Product Displacement System in Warehouses, 11. Decisions in Product Warehousing and Handling, 12. Outsourcing in Logistics / Third Party Logistics (3PL), 13. Contemporary Topics in Logistics
PREREQUISITE
Production Planning and Control, Facilities Desaign
MAIN REFERENCES
Ballou, Ronald. H. (2004) Business Logistics Management, Prentice Hall International, Inc., USA
SUPPORTED REFERENCES
Ghiani, Gianpaolo. (2012). *Introduction to Logistics Systems Planning and Control.* California: John Wiley and Sons, Ltd. Chopra, Sunil (2012). Supply chain Management : Strategy,Planning, and Operation. Prentice Hall International, Inc., New Jersey

COURSE	**TI141319**	**: INDUSTRIAL DESIGN I**
	Credit	: 3 units
	Semester	: VI

COURSE DESCRIPTION	
This course is an integrated course of many previous courses which is aimed for giving the understanding and skills for students in the establishment and development plans of comprehensive business. Students are required to be able to prepare a business feasibility analysis for the establishment and development plans of business. This course is a serial course and will be continued by Business Design Analysis courses in semester 7.	
DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	Ability to identify, to formulate, and to analyze complex engineering problems in an integrated system (including human, material, equipment, energy, and information), both in the service and manufacturing industry, based on considerations and engineering principles
1.1.2	Ability to investigate and to provide a valid conclusion to the complex problem in integrated systems, both in the service and manufacturing industry, by using basic engineering principles and by conducting research (analysis, data interpretation and synthesis of information)

1.1.3	Ability to formulate a solution to a complex problem solving in integrated system, both in the service or manufacturing industry, by considering economic, health and public safety, cultural, social and environmental factors (environmental consideration)
1.1.4	Ability to plan, to design and to control integrated system design, both in the service and manufacturing industry in appropriate with the applicable standards by considering the performance and reliability aspects, the ease of implementation and sustainability, as well as by paying attention to economic, health and public safety, cultural, social and environmental factors (environmental consideration)
2.1.1	Ability in mastering basic quantitative sciences, especially mathematics and statistics
2.1.2	Ability in mastering the basics of engineering sciences which are supporting understanding of the industry
2.1.3	Ability in mastering the principles of management and economics science
2.2.1	Ability in mastering in depth in the field of industrial engineering
2.2.2	Ability in mastering the system theory (including: analysis, design, dynamics, engineering, methodology and systems control) and recent engineering mathematics applications
3.1.1	Ability to work together in both cross-function in organization and cross-organization in business network or supply chain
3.1.2	Ability to make a plan, to execute, and to control over the plan in the situation with limitation of available resources
3.2.1	Ability to make decisions or to give guidance in making the right decisions based on the data / information
3.2.2	Ability to report the outcomes of team work to be used as information for higher organizational hierarchy or for other stakeholders
4.1.1	Ability to manage themselves and to be professional in the work environment
4.2.1	Ability to work in teams proportionally in appropriate with the demands of the job
4.2.2	Ability to communicate ideas systematically, both good oral and written English and Indonesian language
4.3.1	Sensitivity to environmental and sustainability issues as well as to accommodate these issues in the analysis, design, and decision-making
4.4.1	Ability to be creative and innovative in many aspects of life, especially related to the profession or occupied work field

COURSE'S LEARNING OUTCOME

- Students are able to compose a complete / comprehensive and integrated feasibility analysis for the establishment and development plans of manufacturing-based businesses, which in detail:
    - Students are able to design the establishment or development plans of

integrated business, include: opportunities identification, strategic design, product design, manufacturing process design, design and operation of production systems, supply chain design, layout design, business location selection and design of organization and human resources

- Students are able to compose the business plan in a good, rational, and professional feasibility study
- Students are able to communicate / present their work outcomes well
- Students are able to cooperate with other team members in performing design and analysis of business

MAIN TOPICS

1. The need for a complete and integrated feasibility analysis in the establishment and development of manufacturing-based businesses
2. SWOT Analysis of business establishment and development ideas
3. Analysis and arrangement of appropriate strategies for the business establishment and development
4. Market analysis and arrangement of marketing plan
5. Development of a competitive and innovative product design
6. Analysis and arrangement of production process planning
7. Selection of machinery and layout planning and the needs of workers on the production floor
8. Analysis and arrangement of production/ manufacturing systems
9. Analysis and arrangement of supply chain planning, including :
    a. supplier selection
    b. distribution network planning
    c. selection of distribution/ transportation tools
10. Analysis and selection of business location
11. Analysis and layout planning in the business location
12. Arrangement of financing needs based on market aspect and technical aspect

PREREQUISITE

Designing & Product Development, Manufacturing System, Management Organization and Human Resources, Plant Layout, Production Planning and Control

MAIN REFERENCE

Maria Anityasari & Naning Aranti Wessiani, "Analisa Kelayakan Usaha: Dilengkapi Kajian Manajemen Resiko", Gunawidya, 2011

SUPPORTING REFERENCES

Behrens & Hawraner, "Manual for the Preparation of Industrial Feasibility Studies", UNIDO-United Nation Publication, 1992

COURSE	**TI141320**	**: PROBLEM SOLVING METHODOLOGY**
	Credit	: 2 sks
	Semester	: 6

DESKRIPSI MATA KULIAH	
This course aims to provide an overview of potential real problems faced by a graduate of Industrial Engineering in the workplace and in society as well as the solution methodology. Students. Students are directed to be able to find some alternative solutions, problem-solving methods or techniques that can be used, data requirements, constraints and assumptions that are required, and the consequences of each alternative settlement issues raised. In this course, students are trained to think critically, creatively, and innovative in solving problems. Students will be equipped to have the attitude and scientific ethics and skills to explore and extract information, editing and writing reference, scientific communication both orally and in writing, and writing reports and scientific journals from the results of the problem solving that has been done.	
COURSE'S LEARNING OUTCOME SUPPORTED DEPARTMENT	
1.1.1	Able to identify, formulate and analyze complex engineering problems in an integrated system (including human, material, equipment, energy, and information) both in the service or manufacturing industry, based on considerations and engineering principles.
1.1.3	Be able to formulate a solution to a complex problem solving in both the integrated system service or manufacturing industry, with attention to economic factors, health and public safety, cultural, social and environmental (environmental consideration).
1.1.4	Be able to plan, design and control the integrated design system in the service or manufacturing industry in accordance with the applicable standards take into account the performance and reliability, ease of implementation and sustainability, as well as pay attention to economic factors, health and public safety, cultural, social and environmental (environmental consideration).
2.1.1	Mastering basic quantitative sciences, especially mathematics and statistics
2.1.2	Mastering the basics of engineering science that supports understanding of the industry
2.1.3	Mastering the basics of management science and economics
2.2.1	Mastering in depth field of industrial engineering
2.2.2	Mastering the theory of system (include: analysis, design, dynamics, engineering, methodology and control systems) and recent mathematics engineering applications
4.1.1	Be able to manage themselves and be professional in the work environment
4.2.1	Ability to work in teams, in proportion to the requirements of the job
4.2.2	Be able to communicate ideas systematically both orally and in writing in English and in Bahasa Indonesia
4.3.1	The ability to be creative and innovative in many aspects of life, especially related to the profession or field work occupied

COURSE'S LEARNING OUTCOME

- Students are able to recognize and appropriate identify the problems that exist in the work environment and in the community
- Students are able to develop problem-solving methodology that is appropriate, effective and efficient, and involves creativity and innovation
- Students are able to choose the problem solving method / technique appropriate based scientific framework of Industrial Engineering
- Students are able to set boundaries and assumptions in accordance with the conditions of the problems faced
- Students understand the ways of collecting data and information required in problem solving
- Students have the scientific attitude and ethics
- Students have the skills to explore and extract information, editing and writing reference, scientific communication both orally and in writing, and writing reports and scientific journals from the results of the problem solving that has been done

MAIN TOPICS

1. The introduction of typical and potential problems encountered in the workplace and in the community based on laboratories in Industrial Engineering
2. Critical thinking, creative and innovative
3. Problem identification techniques
4. Preparation techniques in a systematic problem-solving methodology and structured, effective and efficient
    a. Various problem solving methods or techniques as well as restrictions assumptions,
    b. A presentation of several final project
5. Attitudes and scientific principles,
6. Skill to explore and extract information
    a. editing and writing references,
    b. scientific communication both orally and in writing, and
    c. writing reports and scientific journals from the results of the problem solving that has been done

PREREQUISITES

Already passed the minimum 100 SKS

MAIN REFERENCE

-

SUPPROTED REFERENCES

1. ITS Guidebook of writing report/ final project
2. Modeling & Problem Techniques for Engineers

COURSE	**TI141321 : MAINTENANCE AND RELIABILITY TECHNIQUES**

	Credit	: 3 credits
	Semester	: 7

COURSE'S DESCRIPTION	
Maintenance and care of the machine play an important role in manufacturing systems. These activities support the sustainability of the process, where in case of damage of the engine then it would impede the course of manufacturing activity. Industrial engineering graduates are prepared to be able to overcome these problems. This course provides explanation about maintenance system in a company, any aspects and tools which need to be maintained, some maintenance techniques with its advantages and disadvantages, the relation between maintenance and other business functions, also how to design efficient maintenance management. This course describes reliability of machines and tools, how to assess it, also how to manage various process condition and/or complex system.	
CAPAIAN PEMBELAJARAN PRODI YANG DIDUKUNG	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.3	To be able to formulate solutions for complex problems on integration system either for service or manufacturing industry, by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
4.2.2	To be able to communicate his/her idea systematically both oral and written in Bahasa Indonesia and English.

4.3.1	To be sensitive to environmental and sustainability issues and to accommodate those issues in analysis, design, and decision making.

COURSE'S LEARNING OUTCOME

Students understand any techniques and maintenance methods, analyze reliability of machines and equipments, also able to identify the need of maintenance in a company with its relation to other business functions.

MAIN TOPICS

1. Strategic roles and operation of maintenance activities in a company.
2. Reliability based maintenance management for various tools and equipments.
3. Maintenance method and techniques (history, implementation, advantages and disadvantages, the need of data, cost of implementation).
4. Computer-based Maintenance Management System (CMMS).
5. Reliability distribution for various tools and equipments (how to measure and analyze manual and using software).
6. Complex system.
7. The use of reliability distribution and model for designing maintenance management.
8. Case study of maintenance and reliability problems.

PREREQUISITE

Industrial Statistics 2, Manufacturing system

MAIN REFERENCES

Lewis, E. E. 1987. Introduction to Reliability Engineering, John Wiley & Sons, USA.

SUPPORTING REFERENCES

Dhillon, B.S, Reiche, H. (1985), Reliabiity and Maintainability Management, Van Nostrand Reinhold Company, USA.

Osaki, S. (1992), Applied Stochastic System Modeling, Springer-Verlag, Tokyo.

Villemeur, A. (1991), Reliability, Availability, Maintainability, and Safety Assessment, John Wiley & Sons, USA

Course Name	**TI141322 : DESIGN OF BUSINESS INFORMATION SYSTEMS (DBIS)**	
	Kredit	: 3 sks
	Semester	: 7

Corse Description

A company or organization will face the challenges of the complexity of the issue and the larger volumes of data, especially when the company has grown and are in a competitive situation. Therefore, in order to survive and be competitive, we need an information system that can support decision making efficiently and effectively. This lecture will provide insight to students related to the design of information systems within the scope of the company or business. Emphasis is on the basic concepts of material information

systems both manual and computer-based, enterprise system basic concepts related functions and levels of management, process / design stage of information systems, business information systems applications design. Understanding of the concept and design of the information system will provide supplies for students to be able to design information systems and applications within the scope of the business

Supported learning Outcome

1.1.1	Able to identify, formulate and analyze complex engineering problems in an integrated system (including human, material, equipment, energy, and information) both in the service industry or manufacturing, based on considerations and engineering principles
1.1.2	Able to investigate and provide a valid conclusion to the problems of complex integrated systems in the service industry or manufacturing use basic engineering principles and to carry out research (analysis, data interpretation and synthesis of information)
1.1.5	Being able to choose and implement resource "design tools and engineering analysis" according to the latest systems engineering activities by considering the limitations
2.1.1	Mastering basic quantitative sciences, especially mathematics and statistics
2.1.2	Mastering the basics of engineering science that supports understanding of the industry
2.1.3	Mastering the basics of management science and economics
2.2.1	Mastering in depth field of industrial engineering
2.2.2	Mastering the theory of system (include: analysis, design, dynamics, engineering, methodology and control systems) and recent engineering applications of mathematics
3.1.1	Can work together in cross-functional and cross-organizational business or organization in a network of supply chain
3.1.2	Able to plan, execute, and exercise control over the plan at the situation with the limited resources available
3.2.1	Being able to make decisions or give guidance in making the right decisions based on the data / information
3.2.2	Could report on the work group to be used as information for higher organizational hierarchy or for other stakeholders

Learning Outcome

- Students understand the relationship of subjects within the scope industrial engineering
- Students understand the basic concepts of information systems both manual and computer-based
- Students understand the relationship of information systems with the functions and levels of management within the scope of the company
- Students understand the system as an alternative solution approach in designing business information systems

- Students understand the framework or model of problem solving (problem solver)
- Students understand the stages in the design of business information systems
- Students are able to model the real case in the framework of information systems design in the form of a data flow diagram
- Students are able to identify the needs of entities and attributes in accordance with the purpose why information systems need to be designed
- Students are able to design information systems in the form of relationships between entities (entity relationship diagram)
- Students are able to design an application system based on the design of the relationship between entities
- Students were able to convince the presentation of the design of information systems through the application system that has been created .

Subject Review

1. The relationship between DBIS with Industrial Engineering
2. Computer-Based Information Systems
3. Information Technology and competitiveness
4. Modeling Enterprise Systems
5. Systems Approach
6. Methodology of Life Cycle Systems
7. Database Management Systems
8. Management Information Systems
9. Normalized Entity Relationship Diagram
10. Case study

Course Requirement

-

Refferences

McLeod Jr. Management Information System,., Prentice Hall, 2004.

Supporting Literature

McLeod. Computer-based information system, Pearson Education, 2003

COURSE	**TI141319 : INDUSTRIAL DESIGN II**
	Credit : 3 units
	Semester : VII

COURSE DESCRIPTION

This course is an integrated course which is a continuation of Industrial Design System (PSI) course. The purpose of this course is to analyze the establishment or development plans of business that have been studied in the PSI course by considering the environmental and social aspects, financial and risk aspects. Based on risk analysis, student are requested to perform a sensitivity analysis and risk management planning. At the end of the course, students are required to justify the comprehensive business feasibility.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	Ability to identify, to formulate, and to analyze complex engineering problems in an integrated system (including human, material, equipment, energy, and information), both in the service and manufacturing industry, based on considerations and engineering principles
1.1.2	Ability to investigate and to provide a valid conclusion to the complex problem in integrated systems, both in the service and manufacturing industry, by using basic engineering principles and by conducting research (analysis, data interpretation and synthesis of information)
1.1.3	Ability to formulate a solution to a complex problem solving in integrated system, both in the service or manufacturing industry, by considering economic, health and public safety, cultural, social and environmental factors (environmental consideration)
1.1.4	Ability to plan, to design and to control integrated system design, both in the service and manufacturing industry in appropriate with the applicable standards by considering the performance and reliability aspects, the ease of implementation and sustainability, as well as by considering to economic, health and public safety, cultural, social and environmental factors (environmental consideration)
2.1.1	Ability in mastering basic quantitative sciences, especially mathematics and statistics
2.1.2	Ability in mastering the basics of engineering sciences which are supporting understanding of the industry
2.1.3	Ability in mastering the principles of management and economics science
2.1.4	Ability in mastering in depth in the field of industrial engineering
2.1.5	Ability in mastering the system theory (including: analysis, design, dynamics, engineering, methodology and systems control) and recent engineering mathematics applications
3.1.1	Ability to work together in both cross-function in organization and cross-organization in business network or supply chain
3.1.2	Ability to make a plan, to execute, and to control over the plan in the situation with limitation of available resources
3.2.1	Ability to make decisions or to give guidance in making the right decisions based on the data / information
3.2.2	Ability to report the outcomes of team work to be used as information for higher organizational hierarchy or for other stakeholders
COURSE'S LEARNING OUTCOME	
• Students are able to compose a complete / comprehensive and integrated feasibility analysis for the establishment and development plans of manufacturing-based businesses by considering social, environmental, financial, and risk aspects, which in detail:	

a. Students are able to conduct feasibility analysis from social, environmental, financial, and risk aspects
b. Students are able to make financial modeling for analyzing business feasibility
c. Students understand the various alternatives of business funding and necessary requirements
d. Students understand the various assumptions which are used in financial modeling and its effects on decision-making
e. Students are able to arrange risk mitigation planning and its costs consequences
f. Students are able to arrange the business design in a good, rational, and professional feasibility study,
g. Students are able to communicate / present their work outcomes well
h. Students are able to cooperate with team members in conducting the business design and analysis

MAIN TOPICS

1. Analysis of the social and environmental impacts of the business establishment and development during pre-construction, construction, and businesses operations including transportation of raw materials and finished goods, demolition (loading-unloading), and so on
2. Various alternatives of available funding to start or expand a business with all requirements
3. Design and Composing of financial modeling to evaluate the feasibility, including capitalization structure (capital), the determination of the parameters and variables that should be included in the financial model along with the assumptions that should be considered
4. The linkage between data of market analysis, technical analysis, environmental and social analysis with a financial feasibility analysis
5. Calculation of Net Present Worth (NPW), Rate of Return (ROR), Payback Period, and the other feasibility parameters
6. Identification and analysis of the risk of a business establishment and development, including making of risk maps, calculation of the consequences of a risk, and risk management plan and cost
7. Sensitivity analysis in decision-making
8. Arrangement of comprehensive and professional business proposals/ feasibility studies

PREREQUISITE

Industrial System Design, Cost Analysis, Engineering Economics

MAIN REFERENCE

Maria Anityasari & Naning Aranti Wessiani, “Analisa Kelayakan Usaha: Dilengkapi Kajian Manajemen Resiko”, Gunawidya, 2011

SUPPORTING REFERENCES

Behrens & Hawraner, “Manual for the Preparation of Industrial Feasibility Studies”, UNIDO-United Nation Publication, 1992

COURSE	TI141324 : INTERNSHIP
	Credit : 2 credit
	Semester : 8

COURSE DESCRIPTION

Internship is designed to introduce students in applying industrial engineering concept and to prepare students for working in the area that the industrial engineer used to works in a company. Also, internship is aimed for the students to understand and apply how to use industrial engineering method in solving the industrial problems comprehensively.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.2	To be able to formulate solutions for complex problems on integration system either for service or manufacturing industry, by considering economic factors, health and public safety, culture, social and environmental considerations.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.
4.2.1	To be able to work in team proportionally in accordance with working demand.
4.2.2	To be able to communicate his/her idea systematically both oral and written in Bahasa Indonesia and English.

COURSE LEARNING OUTCOME

- Students are able to communicate both speaking and writing well.
- Students understand industrial engineering functions.
- Students have experiences to solve industrial problems with industrial engineering functions.

MAIN TOPIC

-

PREREQUISITE

-

MAIN REFERENCES

-

SUPPORTED REFERENCES

-

COURSE	TI141325 : FINAL PROJECT
	Credit : 6 credit
	Semester : 8

COURSE DESCRIPTION	
Students are designed to develop their ability to continue study in graduate level or to work. This final project gives students to have experiences in solving industrial problems. Topics in this final project can be a case study in a company by applying theory, hypothesis testing based on survey data or interview, or a methodology development which can be used in solving industrial problems.	
DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
4.2.2	To be able to communicate his/her idea systematically both oral and written in Bahasa Indonesia and English.
COURSE LEARNING OUTCOME	
• Students are able to think critical and analysis. • Students are able to apply industrial engineering theory in solving industrial problems. • Students can develop their ability in solving problems individually. • Students are able to communicate both speaking and writing well, also to develop *interpersonal skills.*	
MAIN TOPIC	
-	
PREREQUISITE	
Metedologi Penelitian, 2 Mata Kuliah Pilihan	
MAIN REFERENCES	
-	
SUPPORTED REFERENCES	
-	

SILABUS MATA KULIAH PILIHAN

SILABUS KURIKULUM

COURSE	TI141401 : APPLIED INDUSTRIAL ERGONOMICS
	Credit : 3
	Semester : Elective

DESKRIPSI MATA KULIAH
Ergonomics is related to the study of human interaction to improve the work system better. Application of Ergonomics may consider various systems of work by involving the human as the center of study. This course will discuss about evaluation and improvement of working system by considering the advantages and limitations of human follow the principle of Ergonomics.

COURSE'S LEARNING OUTCOME SUPPORTED DEPARTMENT	
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.

COURSE LEARNING OUTCOME
• able to explain the basic concept and application of Ergonomics in the spesific field of real applications • able to analyze the interaction of man-machine-environment-computer system in the specific field of real applications. • able to analyze the reliability and limitations of human beings to manage errors. • able to evaluate a work system in accordance with the principles of Ergonomics.

MAIN TOPICS
1. Review on of Ergonomics development 2. Review on Fisiology & Manual Material Handling 3. Human-Machine Interactions 4. Human-Computer Interactions 5. Human Reliabiity 6. Environmental factors in Ergonomic study 7. Ergonomic application in Manufacturing Industry 8. Ergonomic application in Health Care 9. Ergonomic application in Mining Industry 10. Ergonomic application in Military 11. Ergonomic application in Transportation 12. Ergonomic application for Diafable 13. Ergonomic application for Eldery
PREREQUISITE
Industrial Ergonomics
MAIN REFERENCE
Wickens,C.D., Gordon,S,E., Liu, Y., (2003). An introduction to human factors engineering Pearson, 2nd edition, Pearson Ltd
REFERENCES
Tayyari, Fariborz and Smith, James L. (1997). Occupational Ergonomics: Principles and Applications. Chapman & Hall, London. Salvendy, G. (2012). Handbook of Human Factors and Ergonomics, 4th edition, John Willey and Sons. Granjean, E. (1982). Fitting the Task to the Man: an Ergonomic Approach. Taylor & Fabrics Ltd. Huchingson, Dale R. (1981). New Horizons for Human Factors in Design. McGraw-Hill Book company. Konz, Stephan. (1995). Work Design: Industrial Ergonomics. Scottsdale Publishing Horizons, Inc. Pulat, B. Mustafa. (1992). Fundamentals of Industrial Ergonomics. Prentice-Hall. Sanders, M.S. and McCormick, E.J. (1992). Human Factors in Engineering and Design. McGraw-Hill Inc.

COURSE	**TI141403 : HUMAN RELIABILITY**
	Credit : 3
	Semester : ELECTIVE

DESCRIPTION
The main objective of human reliability is to find credible ways of helping designers, management, operators, and authorities to be able to help increase the safety and profitability of technological systems. Human reliability coupled with probabilistic

risk/safety assessment introduces people to a thought process to perceive risks in operation and help define ways in which the risk can be reduced. During the course, participants will acquire the theory and practical application of human reliability. Several methods will be studied in order to predict, anticipate, and investigate the possibility of human error in the various areas of work.

COURSE'S LEARNING OUTCOME SUPPORTED DEPARTMENT

2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.

LEARNING OUTCOMES

- able to explain the basic concept and application of Ergonomics in the spesific field of real applications
- able to analyze the interaction of man-machine-environment-computer system in the specific field of real applications.
- able to analyze the reliability and limitations of human beings to manage errors.
- able to evaluate a work system in accordance with the principles of Ergonomics.

MAIN TOPICS

1. Introduction to Human Realibility
2. Human Information Processing
3. Human Factors and Supervisory Control
4. Learning Curve
5. Function and Task Analysis
6. Cognitive Reliability Error and Analysis Method
7. Clasiccal Decision Theory (Bayes' Theorem)
8. Methods for Performing Human Reliability & Error Analysis
9. Case Study : Human Error and Quality in several area (Health Care,Railways, Aviation, Shipping, Mining, etc)
10. Field Study on Human Reliability
11. Class Project on Human Reliability

PREREQUISITE

STATISTICS & INDUSTRIAL ERGONOMICS

MAIN REFERENCE
Spurgin, A. (2010). Human Reliability Assessment, Theory and Practice. CNC Press, New York
REFERENCES
Dhillon, B.S. (2007). Human Reliability and Error in Transportation Systems, Springer-Verlag, London
Dhillon, B.S. (2008) Human Reliability, Error,and Quality in Health Care, CRC Press, New York
Dhillon, B.S. (2009). Human Reliability, Error,and Human Factors in Engineering Maintenance, CRC Press, New York
Duffey, R.B., and Saull, J.W. (2008). Managing Risk: The Human Element, John Wiley & Sons, Ltd, United Kingdom
Sandom, C., and Harvey, R.S. (2004). Human Factors for Engineers, The Institution of Engineering and Technology, London
Stanton,N., Hedge,A., Brookhuis,K., Salas,E., and Hendrick, H. (2005). Handbook of Human Factors and Ergonomics Methods, CRC Press, New York

MATA KULIAH	**TI141411 : ANALISIS PRODUKTIVITAS**
	Kredit : 3 sks
	Semester : PIL

COURSE	**TI141411 : PRODUCTIVITY ANALYSIS**
	Credit : 3 credits
	Semester : elective

COURSE DESCRIPTION	
Productivity is the ratio of output to inputs. In manufacturing industry, output defined as products manufactured, and inputs is any resources used. Indonesian industries should increase its productivity to be more more productive and competitive in this global competition. Increasing productivity means giving significant contributions for raising national economics, so that it gains better living standards. An industrial engineer is prepared for solving productivity problem, especially in manufacturing industries. To support this competencies, the department design manufacturing productivity course. This course provides an understanding about productivity concepts, productivity assessment in many types of manufacturing system.	
DEPARTMENT'S LEARNING OUTCOME	
1.1.3	To be able to formulate solutions for complex problems on integration system either for service or manufacturing industry, by considering economic factors, health and public safety, culture, social and environmental considerations.

1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.

COURSE LEARNING OUTCOME

Students understand about the concepts and able to assess productivity, also design the improvement for increasing company productivity.

MAIN TOPICS

1. Course description, learning process, productivity concepts.
2. Productivity cycle (Measurement, Evaluation, Planning, Improvement).
3. Productivity measurement models (3 general classification, measurement model on national level, industries, services, government). Evaluation of the company productivity (steps, productivity benefits, based on the time, classification of approaches).
4. Technology-based productivity Improvements (Automation, CAD, CAM, robotics, application the company).
5. Human-based productivity Improvements (individual and group financial incentives, promotion of labor, enriched the work, etc).
6. Product-based productivity Improvements (Value Analysis & Engineering).
7. Job-based productivity Improvements (work simplification techniques, work measurement, job evaluation, etc.).
8. Objective Matrix
9. Green Productivity
10. Data Envelopment Analysis
11. Productivity measurement for service sector.

PREREQUISITE

Manufacturing System

MAIN REFERENCES

Shigeyasu Sakamoto. 2010. *Beyond World Class Productivity Industrial Engineering Practice and Theory*. Springer-Verlag London Limited.

Sumanth, D.J. 1985. *Productivity Engineering and Management***.** McGraw-Hill, New York.

SUPPORTING REFERENCES

Stephen A. Ruffa. 2008. *Going Lean How The Best Companies Apply Lean Manufacturing.*

New York: AMACOM.
Liker, Jeffrey K and David Meier. 2004. *The Toyota Way Fieldbook.* Mc Graw Hill.
Ohno, Taiichi. 1990. *Toyota Production System.* New York: Productivity Press.

COURSE	**TI141412 : *COMPUTER INTEGRATED MANUFACTURING (CIM)***
	Kredit : 3 credits
	Semester : Elective

COURSE DESCRIPTION

CIM gives student understanding of CIM concept and its components including evaluating, defining strategy and designing a CIM system from upgrading to fully implementation.

LEARNING OUTCOME OF DEPARTMENT

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.3	To be able to formulate solutions for complex problems on integration system either for service or manufacturing industry, by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.

COURSES OBJECTIVES

- Students understand Computer Integrated Manufacturing concept.
- Students know CIM components from planning, manufacturing processes, inspection, and packaging
- Student able to evaluate Computer based Manufacturing System
- Student able to design a CIM system

MAIN CONTENT

1. Overview of CIM Concept
2. CAD/CAM
3. Computer Aided Process Planning
4. Computer Aided Manufacturing Planning & Control
5. Computer Numerical Control
6. Automated Inspection System
7. Automated Material Handling (including Robotic System)
8. Automated Storage and Retrieval System
9. Automated Assembly & Packaging
10. Computer system in CIM
11. Automation system in CIM
12. CIM evaluation
13. CIM system design and implementation strategy
14. Upgrading vs full implementation

PREREQUISITE

Manufacturing System

MAIN REFERENCES

Singh, Computer Integrated Design & Manufacturing, John Wiley & Sons Inc., 1996.

Scheer, Computer Integrated Manufacturing: Towards the Factory of the Future, 2nd ed., Springer-Verlaq, 1991.

Groover, Mikell P., Automation, Production Systems and Computer Integrated Manufacturing.

Yoram Korem, Computer Control of Manufacturing Systems, McGraw Hill, Inc. 1983, 287 pp, ISBN 0-07-035341-7.

SUPPORTING REFERENCES

Singh, V (1997). The Cim Debacle: Methodologies to Facilitate Software Interoperability. Springer. ISBN 9813083212.

De Toni and S. Tonchia, Manufacturing Flexibility: a literature review International Journal of Production Research, 1998, vol. 36, no. 6, 1587-617.

Jean-Baptiste Waldner (1992), Principles of Computer-Integrated Manufacturing, John Wiley & Sons, ISBN 047193450X.

Hannam, Roger, Computer Integrated Manufacturing: from concepts to realisation, Addison-Wesley, Harlow-England,1996

MATA KULIAH	**TI141413**	**: *CONCURRENT ENGINEERING***
	Kredit	: 3 sks
	Semester	: Pilihan

COURSE	TI141413 : *CONCURRENT ENGINEERING (CE)*
	Credit : 3 credits
	Semester : elective

Course Description	
Students gain knowledge and skills in concurrent engineering (collaborative product development) projects, including design for manufacturing and assembly methodologies. Students also learn about CE implementation in different industries from case studies and company representative's experiences.	
SUPPORTED LEARNING OUTCOME OF DEPARTMENT	
1.1.1	Ability to identify, formulate and analyze complex engineering problem in integrated system (man, machine, equipment, material, energy and information) in manufacturing or service industry, based on engineering consideration and principal.
2.1.3	Comprehensive understanding of basic management and economics
2.1.4	Extensive comprehension of Industrial Engineering knowledge
2.1.5	Understanding of system theory and modern application of engineering mathematics

COURSE OBJECTIVES

- Student has knowledge of basic concept and components of C*oncurrent engineering* / collaborative product development.
- Student able to apply CE approach in Manufacturing Industry.
- Student able to identify and analyze any problem related to CE implementation.

MAIN THEME

1. Introduction of Concurrent Engineering
2. CE Elements: Collaboration, Processes and Information Technology
3. Design for Manufacture
4. Design for Assembly
5. Design for X
6. CE implementation in Industry

PREREQUISITE

Product design and development

MAIN REFERENCES

G. Boothroyd, P. Dewhurst, and W. Knight, Product Design for Manufacture and Assembly. Basel, Switzerland: Marcel Dekker AG, 2002

D. M. Anderson, Design for Manufacturability & Concurrent Engineering: How to design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design for Quickly for Fast Production. California: CIM Press, 2006.

T. A. Salomone, What Every Engineer Should Know about Concurrent Engineering: Marcel Dekker, 1998.

SUPPORTING REFERENCES

R. Hartley, Concurrent Engineering : Shortening lead times, raising quality, and lowering cost. New York: Productivity press, 1990.

B. Prasad, Concurrent Engineering Fundamentals: Integrated Product and Process Organization. New Jersey: Prentice Hall PTR, 1996.

K. Otto and K. Wood, Product Design: Techniques in reverse engineering and new product development. Upper Saddle River, New Jersey: Prentice Hall, 2001.

A. Kusiak, Concurrent Engineering: Automation, Tools, and Techniques, John Wiley & Sons, 1992.

COURSE	**TI141414 : MANAGEMENT OF TECHNOLOGY**
	Kredit : 3 sks
	Semester : Pilihan

COURSE DESCRIPTION

Technology is leverage factor for increasing the competitiveness of industry and organization. In order to reach it's success, it doesn't only nessecitate the implementation of appropriate technology development strategy based on content science and technology but also need take into account an supportive environment business precisely and efficiently which must be planned, measurable and integrated. Management of technology concerns interdisiplinier approach to make a planning, development and implement technology capability of organization to accomplish its objective and operational objectives. The course includes a knowledge of science, engineering and management strategy and business. This course help the student being capable to identify, choice, plan, implement and innovate the technology effectively in order to increasing the organization/industry to be competitive.

DEPARTMENT'S LEARNING OUTCOME

1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.

3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.

COURSE LEARNING OUTCOME

- The student are able to develop, innovate and audit of technology in facing the business strategy requirement for being competitive.
- Students are capable to manage a strategic technology in responding the the dynamic of economic environment, costumer value and knowledge based of R & D.

MAIN TOPICS

Introduction and technology conception, Management Technology as New Paradigm, Role of Technology for Value creation, Critical Factor For Management of Technology, Technology Life Cycles; Science and Technology Push Vs Market Pul, diffusion Technology, Processs of InovationTechnology, Road Map of technology transformation, Competitiveness and Indicator, Inovation management, Life Cycle Technology dan production development based , Business Strategy dan Tehnology Strategy "Strategy leader" dan "follower Technology" Technology Planniing : Forecasting Technology, Technology Maping, Knowledge Management, R and D , Technology Portfolio Technology Audit Model (TAM) and technology measurement (Technometrics).

PREREQUISITE

-

MAIN REFERENCES

Buku :

White, M.A and Bruton G.D. 2007. ***The Management of Technology and Innovation: Strategic Approach***. Thompson South Western

SUPPORTING REFERENCES

1. Alamsyah, F.A and Loeis A.M. 2010. *Indonesia Business Cases : From Innovation to Financial Exellence*. Binus Publising.
2. Khalil, T. 2002. *Management of Technology: The Key to Competitiveness and Wealth Creation*. Mc Graw Hill.
3. Thmke, S and Hippel V. E. 2007. *Customer as Innovation : a New Way to Create Value*. Hardvard Busines Review.
4. Alkadri dkk. 2000. *Manajemen Teknologi Untuk Pengembangan Wilayah: Pendekatan Teknometrik*. BPPT-Jakarta.

COURSE	TI141415 : SIX SIGMA
	Credit : 3 credits
	Semester : elective

COURSE DESCRIPTION

Every company has a goal to earn maximum profit by producing good quality products and/or giving the best services to its customers and all stakeholders. The most challenging is how company design working procedures effective and efficient. Furthermore, company need continuous improvements. Six sigma solve system's problems according to continuous improvement insight. Six sigma topic includes continuous process improvement concept, sigma, six sigma leadership organization (belt), DMAIC-DMADV methodology, and six sigma program that used to analyze and give better solutions for both production and service system.

DEPARTMENT'S LEARNING OUTCOME

1.1.1	To be able to identify, formulate and analysis complex engineering problems in integration system (consists of man, material, tools, energy, and information) either for service or manufacturing industry based on engineering considerations and principles.
1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.

COURSE LEARNING OUTCOME

Students are able to use software to determine sigma level, able to formulate and solve company's problems by using six sigma approaches.

POKOK BAHASAN

1. Introduction: Class agreement, quality system, identifying quality functions, quality improvement method (starting from quality control and six sigma), its history and application.
2. Quality improvement system concept, product and service characteristics concept.
3. Product and service development: service in term of six sigma, characteristics and components that need to be improved by using DMAIC and DMADV methodology.
4. Sigma concept and process capability, basic six sigma methods; a. problem solving tools (process mapping, flow chart, check sheet,pareto analisys, RCA), b. 7 tools (affinity, tree, process decision, matric, interrelationship, prioritization, network etc), c. knowlege discovery (run chart, descriptive stat. histogram, explanatory).
5. Six sigma leadership, level of belt in six sigma.

6. Managing six sigma project; quality initiatives, short and long term quality, performance measurement, benefit-cost analysis.
7. Measurement principle; measurement data, collecting data, scales, data reliability and validity, R & R study.
8. Six Sigma: Six Sigma in marketing, Six sigma in project – production, Six Sigma in financing, Six Sigma performance control (designing control mechanism, performance metrices, SCOR model, benchmarking; six sigma - quality improvement in action).

PREREQUISITE

Industrial Statistics I, Industrial Statistics 2, Quality Control Techniques

MAIN REFERENCES

Thomas pyzdek. 2009. *The Six Sigma Handbook, Third Edition. USA : Mc Graw Hill.*

James W. Matin. 2006. *Lean Six Sigma for Supply Chain Management*. Mc Graw Hill.

SUPPORTING REFERENCES

Vincent Gasperz. 2007. *Lean Six Sigma for Manufacturing and Service Industries.*

Vincent Gasperz. 2008. *The Executive Guide to Implementing Lean Six Sigma.*

Kai yang, Basem el-haik. 2003. *Design for Six Sigma.* Mc Graw Hill.

COURSE	**TI141416**	**: SUSTAINABLE MANUFACTURING**
	Credit	: 3 credits
	Semester	: elective

COURSE DESCRIPTION

This course is designed to provide students with an understanding of sustainability issues, the concepts and the scope of SM, the strategies in SM, the management approaches in SM, and tools commonly used in SM. In the current situation, integrating sustainability into business process will enhance business's total performance and competitiveness. Skills developed and knowledge acquired from this course will prepare students to be environmentally conscious engineers who are sensitive to environmentally related problems and capable to solve those problems and enhance total performance of industries.

DEPARTMENT'S LEARNING OUTCOME

1.1.3	To be able to formulate solutions for complex problems on integration system either for service or manufacturing industry, by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.

1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.

COURSE LEARNING OUTCOME

Students understand and able to accomodate environmental issue and its implementation in sustainable manufacturing. Furthermore students are able to integrate sustainability issues in business process for enhancing business performance and company competitiveness.

MAIN TOPICS

1. Global warming and introduction to sustainable development (Concepts, scope, strategies, and regulations related to sustainable manufacturing, overview to broad range of sustainability issues).
2. Reasons for sustainability - macro sustainability issues.
3. Macro sustainability issues & ecological footprint.
4. Regulations related to sustainable development.
5. Sustainability in business proces.
6. Concepts, scope & strategies of SM, Life Cycle Management (LCM).
7. Recycling technologies.
8. Life Cycle Engineering (LCE) – Design for Environment, Design for Manufacture, Design for Assembly
9. Life Cycle Assessment (LCA)
10. Life Cycle Costing (LCC), Product Data Management (PDM)
11. Technical Support

PREREQUISITE

-

MAIN REFERENCES

Billatos, S.B. and Basaly, N.A. 1997. *Green Technology and Design for the Environment*. Taylor & Francis.

SUPPORTING REFERENCES

Curran, M.A. 1996. *Environmental Life-Cycle Assessment*. McGraw-Hill.

Fiksel, J. 1997. *Design for Environment – Creating Eco Efficient Products and Processes*. McGraw-Hill.

Hines, P. and Taylor, D. 2000. *Going Lean*. Lean Enterprise Research Centre, UK.

Steinhilper, R. 1998. *Remanufacturing: The Ultimate Form of Recycling*. Fraunhofer IRB Verlag, Stuttgart.

Proceeding of CIRP International Seminar on Life Cycle Engineering. 1994-2008.

COURSE	**TI141417**	**: ENVIRONMENT MANAGEMENT**
	Credit	: 3 credits
	Semester	: elective

COURSE DESCRIPTION

Environmental management course provides knowledge about management principles related to environment issues, especially in industrial environment, in a planning cycle, implementation and development from R&D department, production, consumption, and recycling. So that environment dimension being integrated with strategic objectives and organisation operational, which is measured by better eco-efficiency.

CAPAIAN PEMBELAJARAN PRODI YANG DIDUKUNG

1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
4.3.1	To be sensitive to environmental and sustainability issues and to accommodate those issues in analysis, design, and decision making.

COURSE LEARNING OUTCOME

MAIN TOPICS

1. Basic concepts of environment system
   a. Business chance and challenges
   b. Economic insentives
   c. Environmental Scanning
2. Managerial solutions and respons
   a. Managerial commitment
   b. Marketing and R&D Management
   c. Material Management (Green Material and Green Product)
   d. Closed Loop Production
   e. Personal Management
   f. Sustainable development
   g. Green Economy
3. Environment policy
   a. Environment Impact Analysis (AMDAL)
   b. Environment Assessment
   c. Clean Product and Design. : LCA and LCC
   d. Eco efficiency
   e. Design for Disasembly
4. Environment Management System
   a. Environment certification concepts, Labeling

b. ISO 14001 and its application
c. ISO 14001 design and implementation.

5. Economic Instruments to Environmental Management:
   a. Economic evaluation methods for environment impact.
   b. Environment assessment.
   c. External cost internalisation.

PREREQUISITE

-

MAIN REFERENCES

Allenby, B., Graedel TE. (1993). ***Industrial Ecology.*** Prentice Hall. New York.

SUPPORTING REFERENCES

Dixon, J.A and M. Hufschmidt. ***Economic Valuation Tehniques For The Environment: A case workbook. The Joint Hopkins*** University Press, 1991.

ISO dan BAN, Implementaing ISO 14000. Environmental Management Systems According to ISO 14001.

Ulhoi J.P. ***Corporate Resources and Environmental Management: What, Why, and What*** ?. TIMS XXXII Conference, Alaska, 1995.

Baum. W. ***Le Cycle des Projets***. Banque Mondiale. 1994

Genne, M. ***Investissement et Environnement: Les Methodes d'Evaluation de Projects***. Economica. 1996.

Soemarwoto, O. ***Analisis Dampak Lingkungan***.Gajah Mada University Press; Jogjakarta. 1990.

North, K. Environmental Business Management. Management Developmenet Series, 1195.

Annoy. ***Business Strategy and the Environment***. Vol.No.1, March 1996, Joint Wiley & Sons.

Tietennberg T. ***Environmmental and Natural Resource Economics***. Scot, Foresman and Company, Boston,1988.

Hotenfenbeck,W. ***The Green Management Revolution: Lessoons in environmental excellence***. Prentice Hall.1992.

De Simone L and F.Popoff. ***Eco Efficiency.The Business Link to Sustainable Development***. The Mit Pres.1997.

MATA KULIAH	**TI141421 : MULTI CRITERIA DECISION MAKING**
	Kredit : 3 sks
	Semester : Pilihan

DESKRIPSI MATA KULIAH

Capability of rational decision making is one of the main attribute for human kind excellence compared to other beings. Science management and techniques of operational research as a decision aid have been developed very well, however it is not enough to be sufficient condition to provide a good decision. The complexity and the situation of decision in system industry facing in the world today, a development of decision model is required in order to make it being effective and by which many different interest and criteria could be naturally measured. To do so it requires a models decision that is not only to reach a solution "global optimal" in single objective but but also to reach a satisfied solution for all perspective of interests. This courses give the student an understanding the theory and the structure and implementing the framework of decision-making process of Multi Objective and Multi Attribute namely MCDM (Multi Criteria Decision Making). This method aims to explain phenomena and to overcoming for decision-making in the ' bounded rationality'. The model does not effectively only to be decision aid to problem facing in decision system in industry as well for the environmental management problem, project evaluation, investment, management of technology also usefull for other issues strategic of decision making. The students are introduced with algortithm, cases, techniques for solving the model and will also discuss riel case study and propos a class project and prepare it for presented at the final course.

DEPARTMENT'S LEARNING OUTCOME

1.1.2	To be able to investigate and give valid recommendations on complex problems on integration system for service and manufacturing industry by using basic engineering principles and conducting researches (analysis, data interpretation, and information synthesis)
1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE LEARNING OUTCOME

The students are able to implement methods and measurement technique preference, decision making by the principle of total agregation and partial out-ranking, the implementation of MCDM in a planning and decision-making and also utilize the various

methods and MCDM's technique to provide information decisive for the decision makers and the planning and to integrate some methods and doing analyzing of the process of decision-making with the relevant MCDM techniq with another methods.

MAIN TOPICS

Review of Optimization Concept, Efficient solution (non dominated solution), scope and development of MCDM theory, prinsicipes dan development of Preference in MCDM, preference assessment and measurement, importance of criteria, single objective approach, unifying objective functions approach, compromise programming, interactive approach, the Step Method, MCDM approach based total outranking –AHP, MCDM based on parsial out ranking, ELECTRE-I and II, PROMETHEE I dan II, DEMATEL, TOPSIS

PREREQUISITE

- Operational Research and Optimization Theory

MAIN REFERENCES

1. Bana e Costa, C.A, *Readings in Multiple Criteria Decision Aid*, Springer Verlag, Berlin, 1994
2. Goicoechea, A., D.R. Hansen and L. Duckstein. ***Multiobjective Decision Analysis with Engineering and Business Applications***. Joint Wiley and Sons, 1982.
3. Tabucanon, M.T.*Multipile Criteria Decision Making in Industry*, Elsevier, 1992
4. Saaty,T.L, *Fundamental of Decision Making in Priority Theory*. RWS Publications, 19

SUPPORTING REFERENCES

1. Europen Journal of Operation Research, Interface Journal, Multi Criteria Decision Making Journal.
2. Maystre L.Y., J.Pictet dan J. Simos. *Methode Multicritere ELECTRE*, Presses Polytechniques et Universitqires Romandes, Lausanne, 1995

COURSE	**TI141422**	**: LARGE SCALE OPTIMIZATION**
	Credit	: 3 credit
	Semester	: Elective

COURSE DESCRIPTION

Business and industrial problems are very rare to have small scale mathematical programming formulations (i.e. less than 100 variables and constraints). Thus, the ability to model large scale and complex formulation in simple and concise representation is very important in solving these problems. This course deals on how to use a high-level language (in terms of algebraic modelling system) for compact representation of large and complex models. The learning method used is lecturer which discuss the algebraic modelling system, how to solve the system in the computer and apply it to specific illustrations of modelling in business and industrial problems. In the last part of the meetings, a project

theme needs to be modelled, solved and presented in a group.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to include other discipline, skill, and modern technique needed into problem solving or integrated system design in service or manufacturing industry.
1.1.2	To be able to control the design process of integrated system in service or manufacturing adaptive-industry.
1.1.5	To be able to deepen and widen the theory in system engineering for in service and manufacturing industry in order to contribute original and reliable research independently.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.1.4	To comprehend in detail industrial engineering knowledge.
2.1.5	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE LEARNING OUTCOME

Students can apply algebraic modelling system for large and complex model in simple and concise representations to solve varies business and industrial problems

MAIN TOPIC

1. Introduction to Algebraic Modelling System (AMS)
2. Structure of AMS model
3. Set definition, variables and data entry
4. Conditional expression and control flow
5. Analysing Solutions
6. Application to business and industrial problems:
   a). Covering and Staffing Models
   b). Networks and Distribution
   c). Multi-period Planning Problems
   d). Decision Making Under Uncertainty and Stochastic Programs
   e). Portfolio Optimization
   f). Multiple Criteria and Goal Programming
   g). Economic Equilibria and Pricing
   h). Game Theory and Cost Allocation
   i). Inventory, Production, and Supply Chain Management
   j). Design & Implementation of Service and Queuing Systems

PREREQUISITE

Advance Operation Research

MAIN REFERENCES

Linus E. Schrage, "*Optimization modeling with LINGO*", Lindo Systems, sixth edition, 2006

SUPPORTED REFERENCES

Richard E.Rosenthal, "GAMS, A User's Guide", GAMS Development Corporation, Washington, DC, USA, 2013

COURSE	TI141423 : DATA MINING
	Credit : 3 credit
	Semester : Elective

COURSE DESCRIPTION

The course aims to discuss about data mining techniques for prediction, classification and clustering and cases in which data mining can be applied, as well as to introduce the use of software for data mining application., which can be applied in some cases.

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.1	To be able to include other discipline, skill, and modern technique needed into problem solving or integrated system design in service or manufacturing industry.
1.1.2	To be able to control the design process of integrated system in service or manufacturing adaptive-industry.
1.1.5	To be able to deepen and widen the theory in system engineering for in service and manufacturing industry in order to contribute original and reliable research independently.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.1.4	To comprehend in detail industrial engineering knowledge.
2.1.5	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE LEARNING OUTCOME

- Understanding the definition, process, scope and current issues of data mining
- Understanding differences in supervised and unsupervised learning
- Understanding of data: data types, dimensions, types of attributes, measuring the similarity and dissimilarity between objects
- Understand and able to perform preprocessing of data
- Understanding the differences in the case of classification, clustering, association and regression
- Understand and able to apply these techniques to cluster, classification, association and regression
- Able to implement the techniques learned by using software
- Able to apply data mining techniques on real case

MAIN TOPIC
• Introduction: definition, process, scope of data mining. Main issues in data mining, • Understanding data • Data preprocessing • Clustering: K-means • Classification Techniques: KNN,Discriminant Analysis • Decision Tree • Frequent Pattern • Support Vector Machine • Data Mining Application
PREREQUISITE
Statistik Industri 2
MAIN REFERENCES
Jiawei Han, Micheline Kamber, and Jian Pei, Data Mining: Concepts and Techniques, 3rd edition, Morgan Kaufmann, 2011.
SUPPORTED REFERENCES
Santosa, Budi, "Data Mining teknik pemanfaatan data untuk keperluan bisnis", 2007 Santosa Budi, "Data Mining terapan dengan matlab", 2007 David Olson, Yong Shi, " Introduction to data mining", McGraw Hill I. H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations", Morgan Kaufmann, 2nd ed. 2005

COURSE	**TI141424 : METAHEURISTIC**
	Credit : 3 credit
	Semester : Elective

COURSE DESCRIPTION	
Teach students how to solve complex optimizations problems easily and efficiently using metaheuristics (with software) without using analytics or Caculus concepts	
DEPARTMENT'S SUPPORTED LEARNING OUTCOME	
1.1.1	To be able to include other discipline, skill, and modern technique needed into problem solving or integrated system design in service or manufacturing industry.
1.1.2	To be able to control the design process of integrated system in service or manufacturing adaptive-industry.
1.1.5	To be able to deepen and widen the theory in system engineering for in service and manufacturing industry in order to contribute original and reliable research independently.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.

2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.1.4	To comprehend in detail industrial engineering knowledge.
2.1.5	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.

COURSE LEARNING OUTCOME

Able to solve nonlinear and discrete optimization using metaheuristics techniques with utilizing software

MAIN TOPIC

- Introduction: types of optimizations problems, optimizations techniques, the impotance of metaheuristics, single and multi modal function
- Review classical optimizations
- Traveling Salesman Problem (TSP), job scheduling as prototype example of combinatorial problem, mathematic formulation of TSP and Job Scheduling
- Simulated annealing (SA) algorithm, using SA to solve continuous and combinatorial problems (TSP or scheduling) both manual and using software
- Particle Swarm Optimization (PSO), using PSO to solve continuous and combinatorial problems manual and using software
- Genetic algorithm, cross entropy, implementation of each technique and compare them using tipical case (suppose TSP with using certain data set)
- Presentation journal papers about metaheuristics application

PREREQUISITE

-

MAIN REFERENCES

Metode metaheuristik, Budi Santosa dan Paul Willy, Graha Ilmu, 2011

SUPPORTED REFERENCES

Santosa B, Matlab untuk statistika dan teknik optimasi , Graha Ilmu, tahun 2007.

Kwang Y Lee and Mohamed A Sharkawi, Modern Heuristic Optimization Techniques, Theory and Applications to Power Systems, Wiley Interscience

COURSE	**TI141432**	**: ENTERPRISE RESOURCE PLANNING (ERP)**
	Credit	: 3 sks
	Semester	: course election

COURSE DESCRIPTION

An ability to understand ERP concepts and an ability to plan and apply some modules in ERP software especially the Oracle EBS software. The topics in this course such as:

- Introduction of Enterprise Resource Planning (ERP)
- Business Process Re-engineering in ERP
- Planning, design and implementation ERP
- Implementer for Oracle E-Business Suites
- ERP systems: inventory management module
- ERP systems Purchasing management module
- ERP systems: Order management module
- Implementation strategy for ERP and best practices
- Practical in lab using Oracle E-Business Suites modules such as inventory management, purchasing management and order management module

DEPARTMENT'S SUPPORTED LEARNING OUTCOMES

1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.
4.3.1	To be sensitive to environmental and sustainability issues and to accommodate those issues in analysis, design, and decision making.

COURSE'S LEARNING OUTCOMES

- An ability to explain ERP system, benefits of ERP, some modules in ERP system, and some real case studies
- An ability to explain the relationships between business process re-engineering and

ERP, some BPR methods in ERP, how application of BPR in ERP, and how application of IT to support ERP

- An ability to explain how planning, designing and implementation of ERP for implementers and users
- An ability to apply some process/activities and Oracle EBS for implementers and users
- An ability to apply some process/activities in Oracle EBS for inventory management.
- An ability to apply some process/activities in Oracle EBS for purchasing management.
- An ability to apply some process/activities in Oracle EBS for order management.
- An ability to explain how the new implementation strategy is used in ERP and best practice (guest lecturer)

MAIN TOPICS

1. Introduction of Enterprise Resource Planning (ERP) (I)
2. Business process re-engineering in ERP (II)
3. Planning, Design and implementation of ERP (III)
4. Implementer for Oracle E-Business Suite (EBS) (IV)
5. Inventory Management (V)
6. Purchasing Management (VI), Order Management (VII)
7. Implementation strategy for ERP and best practices (VIII)

PREREQUISITES

Production Planning Control (PPC) and Accounting Analysisa

MAIN REFERENCES

1. Sumner, M (2005)., Enterprise Resource Planning, 1st Edition, Prentice Hall
2. Sandhya et al (2007), R12 Oracle E-Business Suite Essentials for implementers volume I and II, Oracle Academy
3. Crockett, T & Nanda, M (2007), R12 Oracle Inventory Management Fundamentals, Volume I and II, Oracle academy
4. Mitchell, V & Simpson, D, F (2009), R12 Oracle Purchasing Fundamentals Volume I dan II, Oracle academy

SUPPORTING REFERENCES

COURSE	**TI141433**	**: BUSINESS PROCESS RE-ENGINEERING**
	Credits	: 3 sks
	Semester	: Course election

COURSE DESCRIPTION

An ability to understand the business process re-engineering concepts, to analysis the process flows and variability, to apply the business process modeling techniques and to use the business process software in lab

DEPARTMENT'S SUPPORTED LEARNING OUTCOME

1.1.4	To be able to plan, design and control integration system design on service and manufacturing system which comply valid standard and rules by considering performance and reliability aspects, application and sustainability simplicity, also by considering economic factors, health and public safety, culture, social and environmental considerations.
1.1.5	To be able to select resources and apply current engineering design and analysis tools which suitable for conducting system engineering activities with considering the constraints.
2.1.1	To comprehend basic quantitative science, especially mathematics and statistics.
2.1.2	To comprehend basic engineering to support industrial engineering knowledge.
2.1.3	To comprehend basic management and economics.
2.2.1	To comprehend in detail industrial engineering knowledge.
2.2.2	To comprehend system theory (including: analysis, design, dynamics, engineering, methodology and system control) and application of up-to-dated engineering mathematics.
3.1.1	To be able to work in cross-functional organization or inter-organization level in business and supply chain network.
3.1.2	To be able to plan, execute, and to control that plan in the situation of limited resources.
3.2.1	To be able to make a decision or to give direction in decision making correctly based on data and information.
3.2.2	To be able to report the group's work outcome to be used as information for higher organizational level or other authorized body.
4.3.1	To be sensitive to environmental and sustainability issues and to accommodate those issues in analysis, design, and decision making.

COURSE'S LEARNING OUTCOMES

- An ability to explain business process re-engineering concept such as basics of BPR concepts, relationships between business strategy and process business, application of BPR and generics BPR model and its applications.
- An ability to analysis flow and variability of process in some application of BPR in manufacturing, hospitals, banks and others.
- An ability to apply the business process mapping such as descriptive, multi-level, simulation and object oriented
- An ability to apply the business process improvement methods and it's applications

MAIN TOPICS

1. Basics concepts of business process re-engineering (I)
2. Business strategy and business process (II)
3. Generics business process model) (III)
4. Process flows analysis (IV)
5. Process flow variability (V)
6. Business process modeling techniques such as flow chart and cross-functional chart), multilevel technique (IDEF0), discrete simulation technique (Petri nets) (VI)
7. Object oriented techniques (EPC, UML etc) (VII)

8. Business process improvement methods (value stream mapping, six sigma, and lean etc) (VIII) 9. Business process improvement software (IX)
PREREQUISITE
-
MAIN REFERENCES
1. Anupindi, R, Chopra, S, Deshmukh, Van Mieghem, J dan Zemel, E (2006), Managing business process flows, Prentice-Hall 2. Damelio (1996), Basic of mapping business process, Productivity Press 3. Brocke dan Rosemann (2010), Handbook of business processes management, Springer
SUPPORTING REFERENCES
1. Davis and Brabander (2007), ARIS design platform, Springer. 2. Peterson (1981), Petri net theory and the modelling of system, Prentice-Hall

SILABUS MATA KULIAH LAYANAN ITS