	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE : Introduction to Mechanical Engineering	**COURSE CODE : TM201401**
	Semester 1/2 credits

Provide an initial overview of mechanical engineering science by outlining the scope, fields, and relationships of Mechanical Engineering with other sciences. Through this course, students are expected to be able to understand the application and science of mechanical engineering in various sectors. The subjects studied are related to the history of mechanical engineering, sub-fields of mechanical engineering such as Energy Conversion, Manufacturing, Metallurgy and Mechanical Design and Ethics and the Mechanical Engineering Profession. In this course, students will be introduced to the basic concepts of mechanical design, forces, structures, materials, manufacturing processes, engine transmissions, fluid mechanics, energy and heat therefore students have an overview of the mechanical engineering profession and are able to explain a product of mechanical engineering.

Intended Learning Outcomes (ILO)

ILO.1	An ability to communicate effectively in oral and written manners with a range of audiences
ILO.2	An ability to identify, formulate, analyse, solve problems, and make informed judgments, which must consider the impact of the solutions within realistic constraints in such aspects as law, economic, environment, social, politics, health and safety, sustainability as well as to utilize information technology and the potential of national resources with global perspective.

Course Learning Outcomes (CPMK)

Able to explain the history of mechanical engineering, mechanical engineering sub-fields such as Energy Conversion, Manufacturing, Metallurgy and Mechanical Design along with Ethics and the Mechanical Engineering Profession, so that students can provide an overview of the mechanical engineering profession and be able to explain the application of mechanical engineering science in various sectors.

Study Material

1. History of mechanical engineering
2. Mechanical engineering sub-fields such as Energy Conversion, Manufacturing, Metallurgy and Mechanical Design
3. Ethics and the profession of mechanical engineering.
4. Basic science of mechanical design : force, structure, material, manufacturing process, engine transmission, fluid mechanics, energy and heat

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Prerequisite Course
1. -
Main Library
1. Jonathan Wickert & Kemper Lewis (2016). "An Introduction to Mechanical Engineering", Third Edition, Global Engineering.
Support Libraries
1. J. Paulo Davim (2018)., "Introduction to Mechanical Engineering", 1st Edition, Springer International Publishing. 2. Michael Clifford, Richard Brooks, Alan Howe, Andrew Kennedy, Stewart McWilliam, Stephen Pickering, Paul Shayler and Philip Shipway (2009). "An introduction to Mechanical Engineering. Part 1", Hodder Education. 3. Michael Clifford, Richard Brooks, Kwing-So Choi, Donald Giddings, Alan Howe, Thomas Hyde, Arthur Jones, and Edward Williams (2010). "An introduction to Mechanical Engineering. Part 2", Hodder Education.

COURSES: Technical Drawing	**COURSE CODE: TM201402**
	Semester 1/3 credits
Course Description	

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Technical drawings teach basic technical drawing standards consisting of projections, symbols and lines so that they are able to read and write about an object design or construction based on ISO standards.

Intended Learning Outcomes (ILO)

ILO.1	an ability to communicate effectively in oral and written manners with a range of audiences
ILO.5	an ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.

Course Learning Outcomes (CPMK)

Able to design technical drawings according to ISO standards

Study Material

1. Principle of drawing
2. Drawing tools
3. line type
4. Geometry synthesis
5. Projection
6. sketch drawing
7. Custom Projection and Cropped Image
8. Auxiliary views and snippets
9. Dimensions, tolerances, workmanship file

Prerequisite Course

1. -

Main Library

1. Anonymous (2002). Technical Drawing: ISO Standard Hand Book volume 12

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Support Libraries

1. Ir. Ohan Juhana, M Suratman S.Pd (2000). Drawing Mechanical Engineering According to ISO Standard: Graphics Library
2. Sato, Takeshi G., and N. Sugiharso H., (1996) Drawing Machines According to ISO Standards: Pradnya Paramitha

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COURSE : Machine Drawing	**COURSE CODE: TM201403**
	Semester 2/ 3 credits

Course Description

Drawing Machines teaches computer-aided technical drawings, including drawings of parts, assembly and symbols on the layout, read and make arrangement drawings and detailed drawings (details) with computer programs. know and understand about tolerance, adaptation and application.

Intended Learning Outcomes (ILO)

ILO.1	an ability to communicate effectively in oral and written manners with a range of audiences
ILO.5	an ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.

Course Learning Outcomes (CPMK)

Able to design 2D and 3D drawings with the help of computer programs

Study Material

1. Program introduction
2. Basic 3D drawing techniques
3. Assembly
4. 2D drawing layout 3D configuration
5. Toolbox
6. Animation Assembly
7. Simulation Lay out

Prerequisite Course

1. Technical Drawings with a minimum value of D

Main Library

1. Frederick E.,(2016) Technical Drawing with Engineering Graphics: Prentice Hall, New York

Support Libraries

1. Anonymous (2002). Technical Drawing: ISO Standard Hand Book volume 12
2. Sato, Takeshi G., and N. Sugiharso H., (1996). Drawing Machines According to ISO Standards: Pradnya Paramitha

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Structural Statics	**COURSE CODE: TM201404**
	Semester 2/ 3 credits

Course Description

This course applies Newton's Laws and the concept of free body diagrams. Its purpose is to equip students in understanding the influence of forces in the system, both the load given is in the form of a concentrated load, or a distributed load. A given system specifically on a certain static.

Intended Learning Outcomes (ILO)

ILO.6	an ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

able to analyse the static balance of particles and structures, especially certain static structures, as well as compose systems and force field diagrams on the balance of rigid bodies due to various distributed and concentrated loads.

Study Material

1. Newton's laws & concepts Free body diagrams
2. Types of support
3. Certain Static Structure
4. Distribution and centralized load
5. Internal style
6. Friction
7. Pseudo working method
8. moment of inertia

Prerequisite Course

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Main Library

1. Cannon, Statics Volume 1 Second Edition
2. Russel C. Hibbeler, Engineering Mechanics: Statics, 12th edition, Prentice Hall

Support Library

1. Sidharta S. Kamarwan, Second Edition of Statics, 1995
2. FP Beer and ER Johnston Jr., Vector Mechanics for Engineers: Statics, SI Metric Edition, 9th Edition, McGraw-Hill,

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COURSE : Thermodynamics I	**COURSE CODE: TM201405**
	Semester 3/ 3 Credits

Course Description

Thermodynamics I is a very important basis in the world of engineering, especially in its use such as vehicle engines, generating systems. This course focuses on the introduction of the basic concepts of thermodynamics, the thermodynamic system that occurs, the laws of thermodynamics, the ideal gas model used and volume energy analysis. So that students can understand and master the related thermodynamic systems that occur and the application of the use of these thermodynamic systems.

Intended Learning Outcomes (ILO)

ILO.5	an ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.
ILO.6	an ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

Able to calculate and analyse thermodynamic systems from each level of thermodynamic state

Study Material

1. Thermodynamic System
2. I Law of Thermodynamics
3. Nature and degree of state
4. The ideal gas model, an incompressible substance
5. Control volume energy analysis

Prerequisite Course

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Main Library

1. Cengel, Yunus A. & Boles, Michael A., Kanoglu, Mehmet (2019). thermodynamics ; an engineering approach, 9 th Edition, New York : McGraw-Hill

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Support Libraries

1. Effendy Arif (2012). Engineering Thermodynamics, Makassar : Grounding Publishing
2. Holman J.P (1985). Thermodynamics, 4th Edition, New York : McGraw-Hill
3. Spalding DB & Cole E.II (1973). Engineering Thermodynamics, 3th Edition, London : Edward Arnold ltd

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSES: Engineering Mathematics	**COURSE CODE: TM201406** Semester 3 / 3 credits

Course Description

This Engineering Mathematics course is a mandatory course which is a continuation of the material in the Calculus II Course and places more emphasis on the application of mathematics in solving engineering problems, especially in case studies related to mechanical engineering. The Engineering Mathematics course provides knowledge and skills about linear algebra, fold integrals, vector calculus, Fourier series, Laplace transforms, complex variable functions, differential equations, partial differential equations and can apply them to engineering problems. These basics are the basis for students in solving problems in the field of mechanical engineering.

Intended Learning Outcomes (ILO)

ILO.2	an ability to identify, formulate, analyse, solve problems, and make informed judgments, which must consider the impact of the solutions within realistic constraints in such aspects as law, economic, environment, social, politics, health and safety, sustainability as well as to utilize information technology and the potential of national resources with global perspective.
ILO.7	an ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to calculate and formulate solutions to problems in the field of mechanical engineering using an analytical approach

Study Material

1. Ordinary Differential Equation
2. Partial Differential Equation
3. Legendre's Equation
4. Bessel's Equation
5. Laplace Transform
6. Differential Operator
7. Fourier Series
8. Taylor Series

9. Matrix and Determinants

Prerequisite Course

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Main Library

1. Erwin Kreyszig. (2011). Advanced Engineering Mathematics. United States of America : John Wiley & Sons.

Support Libraries

1. Wilfred Kaplan. (2002). Advanced Calculus 5st Edition, China : Pearson Addison .

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Mechanics of Material Strength	**COURSE CODE: TM201408**
	Semester 3/ 4 credits

Course Description

In this course, students will be provided with a theory of static failure of materials according to material conditions, analyse the strength, deflection, and buckling of certain and unspecified static structures, and be able to understand the use of energy methods for material design, both individually and collectively in the design of materials. a group.

Intended Learning Outcomes (ILO)

ILO.7	an ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

students are able to analyse deflections, stresses, and strains as the basis for designing the strength, stiffness, and stability of truss and frames.

Study Material

1. Stress Strain
2. Mechanical properties of the material
3. Voltage
4. Deflection
5. Mohr Circle
6. Damage theory
7. Buckling
8. Indeterminate static structure

9. Energy method (Castigliano)

Prerequisite Course

Structural Statics

Main Library

Russel C. Hibbeler, Mechanics of Materials, 8th edition, Prentice Hall

Support Library

1. FP Beer and ER Johnston Jr., Mechanics of Materials, 6th Edition, McGraw-Hill
2. JM Gere and BJ Goodno (2012), Mechanics of Materials Brief, SI Edition, Cencage Learning

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSES : Statistics and Probability	**COURSE CODE: TM201407**
	Semester 3 / 3 credits

Course Description

This Statistics and Probability course is a compulsory subject that discusses statistics and probability and their application in the field of mechanical engineering. By following this course students are able to use statistical methodologies in solving engineering problems; calculate and interpret descriptive statistics using numerical and graphic methods; understand the basic concepts of probability, random variables, probability distributions, and combined probability distributions; able to calculate point estimates of parameters, explain sampling distributions, and understand the central limit theorem; and able to construct confidence intervals on the parameters of one sample.

Intended Learning Outcomes (ILO)

ILO.3	an ability to collaborate effectively in multidisciplinary and multicultural team whose members together provide leadership to achieve the objectives

Course Learning Outcomes (CPMK)

Able to calculate the basic completion of applied statistics and the probability of an event and able to practice solving statistics using the help of software.

Study Material

1. The concept of probability and probability together.
2. Conditional probability.
3. Discrete random variables.
4. Continuous random variable.
5. Data representation.
6. Descriptive statistics.
7. Estimation (One sample).
8. Hypothesis testing (One sample).
9. Hypothesis testing (One sample).
10. Estimation and two-sample hypothesis.
11. Paired data and correlation.

12. Regression and ANOVA

Prerequisite Course

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Main Library

David S Moore, George P McCabe, Bruce A Craig. (2016). Introduction to the Practice of Statistics. New York : WH Freeman and Co.

Support Libraries

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COURSE: Engineering Measurement	**COURSE CODE:TM 201410** Semester 3/ 3 Credits

Course Description

Measurement is fundamental and has always been done in engineering and science. In every analysis, the development of a mechanical system always involves direct or indirect experiments. This will work well if it is supported by measurement methods, precise and valid interpretation of data from one or a collection of observations. The engineering measurement course will introduce students to the basics of measurement techniques, concepts, and frequently used terms. Mathematical background will also be introduced. Furthermore, classical and modern measurement methods commonly used to record engineering and scientific parameters such as displacement, motion, stress, force, flow, pressure, and temperature will be discussed in this lecture.

Intended Learning Outcomes (ILO)

ILO.2	an ability to identify, formulate, analyse, solve problems, and make informed judgments, which must consider the impact of the solutions within realistic constraints in such aspects as law, economic, environment, social, politics, health and safety, sustainability as well as to utilize information technology and the potential of national resources with global perspective.
ILO.5	an ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.

Course Learning Outcomes (CPMK)

Able to use, analyse and test the performance of various types of sensors including strain gauges, thermocouples, tachometers, transducers, dynamometers, pressure gauges, laser and Doppler velocimeters, pressure probes, and flowmeters.

Study Material

1. Introduction to measurement techniques
2. Digital Techniques in Measurement
3. Data Processing
4. Displacement/Position Measurement

5. Strain and Stress Measurement
6. Force and Torque Measurement
7. Pressure Measurement
8. Flow Measurement
9. Temperature Measurement
10. Movement Measurement
11. Special Topic

Prerequisite Course

1. Calculus 1 and 2, Basic physics 1 and 2, Statistics

Main Library

1. Holman, JP (2012). Experimental methods for engineers. New York: McGraw-Hill.

Support Libraries

1. Northrop, RB (2014). Introduction to instrumentation and measurements. Boca Raton: Crc Press, Taylor & Francis Group.
2. Wheeler, AJ and Ganji, AR (2010). Introduction to engineering experimentation. Boston: Prentice Hall.
3. Beckwith, TG and Marangoni, RD (2009). Mechanical measurements. Upper Saddle River, New Jersey: Pearson Prentice Hall.
4. Figliola, RS and Beasley, DE (2019). Theory and design for mechanical measurements. Hoboken, Nj: Wiley.

Institut Teknologi Kalimantan	**SYLLABUS** **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE : Fluid Mechanics I	**COURSE CODE: TM201411**
	Semester 3 / 3 Credits

Course Description

Fluid Mechanics is a branch of mechanics that studies the phenomena that occur in macroscopic fluids. Fluid Mechanics I is the basis of the Fluid Mechanics II course discussing the basic concepts of fluid mechanics, including the types and classification of fluids, the scope of fluid mechanics, fluid statics, as well as approaches by developing mathematical modeling in integral form for control volumes, and dimensional analysis, similarity, and model studies. Fluid mechanics applications in everyday life, for example, calculate the power required to pump a fluid to a place. Learning is carried out in class and practicum, so that students have the opportunity to apply the theory they get directly in the laboratory. With this course, students are expected to be able to understand the basic concepts of fluid mechanics and be able to apply the basic equations of fluid mechanics, which will then be used as the basis for studying Basic Fluid Mechanics II courses.

Intended Learning Outcomes (ILO)

ILO.6	an ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.7	an ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to implement the basic concepts of fluid mechanics in related problems (C3)

Study Material

6. Fluid properties
7. Continuum concept
8. Fluid statics (pressure and its measurement, forces, fluid in a rigid container in motion)
9. Fluid dynamics (fluid kinematics, stagnation and pressure dynamics, differential analysis, control volume)

10. Fundamental laws of fluid flow (Euler, Bernoulli, Cauch, Navier Stokes, Reynolds theorem, energy press)
11. Dimensional analysis (pi-Buckingham theorem, tuna dimension and similarity parameters)

Prerequisite Course

1. Basic Physics I and II

Main Library

1. Robert W. Fox, Alan T. McDonald, and PJ Pritchard (2004). “Introduction to Fluid Mechanics”, Sixth Edition, New York : John Wiley & Sons Inc.

Support Libraries

1. Bruce R. Munson, Donald F. Young, and Theodore H. Okiishi (1998). “Fundamentals of Fluid Mechanics”, Third edition, New York : John Wiley & Sons Inc.

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Engineering Materials I	**COURSE CODE: TM201409**
	Semester 3 / 3 Credits

Course Description

Materials Techniques to discuss the properties and behavior of various types of materials, related to the manufacturing process and specific use requirements.

Intended Learning Outcomes (ILO)

ILO.7	an ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to analyse data and explain logically phenomena in steel and alloy transformation

Study Material

1. Material Type and Application
2. Mechanical Properties and Examiners
3. Technological Properties
4. Atomic theory, crystal defects, crystallography and dislocation
5. Phase diagram
6. Steel and Alloy
7. Heat Treatment
8. Alloy
9. Code and Standard

Prerequisite Course

1. Does not have prerequisite courses

Main Library

1. Kalpakjian (2006), Manufacturing Engineering and Technology : 6th Ed., Digital Designs

Support Libraries

1. Flinn & Trojan (1995), Engineering Materials and Their Applications : John Wiley & Sons, Inc.
2. James A. Jacobs & Thomas F. Kilduff (2004), Engineering Materials Technology: Prentice-Hall, Inc.

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COURSE : Machine Element I	**COURSE CODE: TM201412** Semester 4/ 3 credits

Course Description

students will learn to understand the concepts and stages in designing machine elements from ideas to products. After that, students are taught how to design machine elements which include rivets, welds, bolts and designing shafts along with pegs and couplings. In addition, students also learn to analyse the material strength of various machine elements that have been designed. To find out the depth of understanding of the design concept and the strength of machine elements, students will present examples of failure cases due to improper design.

Intended Learning Outcomes (ILO)

ILO.7	an ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Students are able to understand the concept of designing machine elements and fatigue failure theory, designing various kinds of machine elements (connections, shafts and pegs, clutches, brakes, springs), and analyzing the strength of the selected machine element materials, either individually or collectively. in a group.

Study Material

1. How the machine element works
2. Stress analysis and design process
3. Process design
4. Connection types

5. Bearing
6. Spring

Prerequisite Course

1. Material Strength Mechanics I
2. Materials Engineering

Main Library

1. Khurmi RS & Gupta JK (1980). A Text Book of Machine Design, Eurasia Publishing House Ltd, New Delhi,
2. Shigley's, Mechanical Engineering Design, Tenth Edition, McGraw Hill Education,

Support Library

1. Paul H. Black (1968). Machine Design, New York : McGraw-Hill,
2. Stolk J & Kros C (1981). Machine Elements (Hendarsin Translation), Jakarta : Erlangga
3. Sularso (1978), Basic Planning and Selection of Machine Elements, Jakarta : Pradnya Paramita

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Heat and Mass Transfer I	**COURSE CODE: TM201413**
	Semester 4/ 3 credits

Course Description

Heat and mass transfer I is one of the basic courses that is always used in analyzing a situation that occurs in the design of mechanical systems, especially in the thermal field. This course will discuss the concepts of heat and mass transfer and the types of heat transfer by conduction in particular, so that at the end of this course students are able to know and analyse phenomena that occur from the design of mechanical systems, especially conduction in the thermal field. Learning activities consist of lectures that discuss theories and assignments that are done independently and in groups.

Intended Learning Outcomes (ILO)

ILO.6	an ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

Able to formulate and analyse the types of heat and mass transfer specifically conduction heat transfer to determine the phenomena that occur in a mechanical system

Study Material

1. Concept of Heat and Mass Transfer
2. Thermal Properties of Materials
3. Steady state conduction
4. Transient conduction

Prerequisite Course

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Main Library

1. Cengel, Y. A & Ghajar A. J (2011), Heat and Mass Transfer: Fundamentals and Applications, 4th Ed, New York : MC Graw-Hill

Support Libraries

1. Lienhard IV , John H., and Lienhard V, Jhon H., A (2001), Heat Transfer Textbook , 3th Ed, USA : Phlogiston Press Cambridge
2. Kreith, F.; Boehm, RF; et. Al (1999), Heat and Mass Transfer. CRC Press LLC
3. Bejan, Adrian., Kraus, Allan D (2003), Heat Transfer Handbook, New Jersey : John Wiley & Sons

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Materials Engineering II	**COURSE CODE: TM201414**
	Semester 4 / 3 credits

Course Description

Materials Engineering II is a follow-up course after Materials Engineering I which discusses mechanical properties, technological properties of phase diagrams, steel and alloys, heat treatment allow and standard codes for testing mechanical properties and material codes and others. This course has links to other courses such as mechanical elements, fracture mechanics and metal fatigue and basic chemistry. Students understanding will be shown through practicum, post-test and pre-test through the pre-selected Materials Engineering grader, the theory from Materials engineering I learning will be put into practice in Materials engineering II.

Intended Learning Outcomes (ILO)

ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to process, implement, and adapt theoretical knowledge to the results of the practicum carried out.

Study Material

1. Dislocation , Slip, twinning, yield phenomena
2. Metal Reinforcement Method
3. Deformation
4. Fatigue
5. Metal Etching
6. Practice

Prerequisite Course

1. Materials Engineering I

Main Library

1. Suherman Wahid (2003) Metal Science I, Department of Mechanical Engineering FTI ITS, Surabaya,

Support Libraries

1. Avner, Sydney H (1982). Introduction to Physical Metallurgy, Second Edition, McDraw-Hill International Booj Company, Tokyo,
2. Callister, William D. Jr. (2007), Materials Science and Engineering, John Wiley & Sins Inc., New York,
3. Saptono Rahmat (2008), Iron-Based Metals and Alloys, Department of metallurgy and materials, University of Indonesia.

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE : Fluid Mechanics II	**COURSE CODE: TM201411** Semester 4/ 3 Credits

Course Description

This course discusses the concepts of viscous fluid flow in channels including the types of flow and losses caused, the concept of external flow, the concept of ideal fluid flow, the concept of compressed flow and practicum to add insight in problem design and solution methods in all learning so that students able to apply to applied courses and related electives.

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts
ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to calculate and analyse losses in the flow in the channel and identify the type of external and compressible flow

Study Material

1. Viscous fluid flow in the channel (laminar, turbulent, fully develop, moddy diagram, minor loss and major loss)
2. External Flow (characteristics, lift and drag, boundary layer)
3. Ideal fluid flow
4. Compressible flow (ideal gas, mach number and speed of sound, isentropic and non-isentropic flow)
5. Practice

Prerequisite Course

1. Fluid Mechanics 1

Main Library

1. Robert W. Fox, Alan T. McDonald, and PJ Pritchard (2004), “Introduction to Fluid Mechanics”, Sixth Edition, New York : John Wiley & Sons Inc

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Support Libraries
1. Robert W. Fox, and Alan T. McDonald (1998), "Introduction to Fluid Mechanics", Fifth Edition, New York : John Wiley & Sons Inc. 2. Irving H. Shames (1992), "Mechanics of Fluids", Third Edition, New York : McGraw-Hill Inc., ,.

COURSE : Mechanism Kinematics	**COURSE CODE: TM201416**
	Semester 4/ 2 Credits

Course Description

Students will learn about particle motion, rigid bodies, and mechanisms. Graphic methods for motion analysis are discussed so that students have the ability to complete motion analysis efficiently and practically, and are able to visually interpret the motion of objects. Analytical methods are also discussed so that students are able to perform computations for the analysis and synthesis of motion of objects. Case studies of the analysis of the motion of objects in various types of mechanisms are discussed in this lecture. The goal is that students have experience in solving practical problems and learn to think critically about the use of kinematics in various fields, especially mechanical mechanisms so that they are able to make the right decisions.

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

Students are able to identify motion problems and choose the right method to analyze them.

Study Material

1. Pole point Instantaneous velocity
2. Simple mechanism
3. speed and acceleration analysis
4. Help point method
5. Rolling phenomenon
6. Equivalent mechanism

Prerequisite Course

Structural Statics

Main Library

1. George Martin (1982), "Kinematics and Dynamics of Machine Second Martin",McGraw-Hill
2. JS Rao(2011), "Kinematics of Machinery Through Hyperworks", Springer

Support Library

1. Holowenko (1992), "Machinery Dynamics", Erlangga.
2. Norton, Robert L.(2004), "Design of Machinery", 3rd edition, New York : McGraw-Hill
3. Waldron, Kenneth L., and GL Kinzel (1999), "Kinematics, Dynamics, and Design of Machinery", New York : John Wiley & Sons,
4. Holowenko, AR(1995), "Dynamics of Machinery", New York : John Wiley & Sons
5. Kimbrell, Jack T. (1991), "Kinematics Analysis and Synthesis, New York : John Wiley & Sons

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	Semester 4/ 3 Credits

Course Description

Thermodynamics II is a very important basis in the world of machinery and the industrial world, especially in power generation systems. In generating power in machinery and generating systems, it is necessary to know in advance about the system that works on the engine and generating system. In this course, the materials are focused on the cycles that occur from the engine and generating system, analyzing the system that occurs so that thermal efficiency is obtained related to the output power of an engine and generating system. So that students can understand and have experience related to the system that occurs in the engine and generating system.

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts
ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to calculate, analyse and apply the Second Law of Thermodynamics and the thermic cycle

Study Material

1. Entropy and the Second Law of Thermodynamics
2. Standard air power cycle (Carnot Cycle, Otto Cycle, Diesel Cycle, Combined Cycle, Brayton Cycle and Jet Propulsion Cycle)
3. Vapor Cycle (Rankien Cycle, Vapor Compression Refrigeration Cycle)
4. Unreacted Mixture (Psycometric)
5. Mixture reacts (combustion)

Prerequisite Course

1. Thermodynamics I

Main Library

1. Effendy Arif (2012), Engineering Thermodynamics, Makassar : Grounding Publishing

Support Libraries

3. Holman JP(1985) , Thermodynamics, 4 th Edition, McGraw-Hil
4. Reynolds WC & Perkins HC (1983), Engineering Thermodynamics, 2 nd Edition, McGraw-Hill
5. Spalding DB & Cole E.II (1973), Engineering Thermodynamics, 3th Edition, London : Edward Arnold ltd

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Heat and Mass Transfer II	**COURSE CODE: TM201418**
	Semester 5/ 3 Credits

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Course Description

This course discusses the concepts of conduction and convection heat transfer, construction of heat exchangers, configuration of heat exchangers (the arrangement of tubes), heat exchanger bulkheads, cells and tubes and the impurities that occur in heat exchangers, procedures for planning exchangers. heat. After taking this course, students are expected to understand the concepts of heat exchangers and their interrelationships and be able to apply them to the mechanical engineering field.

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts
ILO.	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to understand and analyse the basics of convection and radiation and their application

Study Material

1. Basics of convection (similarity, general equations)
2. Fundamentals of mass transfer
3. External flow forced convection (flat plate, cylinder, sphere, bundled tube)
4. Inner flow forced convection(cylindrical, non-cylindrical)
5. Heat exchangers (LMTD and NTU-e)
6. Free convection and combination
7. Radiation (black body, Wien's law, radiation characteristics, Kirchhoff, form factor)
8. Practice

Prerequisite Course

Thermodynamics I and II, Heat and Mass Transfer I

Main Library

Incropera, Frank P., and David P. De Witt (2001), “Fundamentals of Heat and Mass Transfer”, 6th ed., New York: John Wiley and Sons

Support Libraries

1. Holman, JP,(2002) “Heat Transfer”, 9th Ed, New York : McGraw-Hill Inc.
2. Cengel, YA (1998), “Heat Transfer”, McGraw-Hill
3. Adrian Bejan (1993), “Heat Transfer”, New York : John Wiley and Sons

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Dynamic and Control Systems	**COURSE CODE: TM201419**
	Semester 5 / 3 credits
Course Description	

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This Dynamic and Control System course is a compulsory subject that provides knowledge and skills about dynamic system modeling, especially in mechanical, electrical, and pneumatic, hydraulic systems. After understanding about dynamic systems, students are able to design control systems based on the characteristics of these dynamic systems. To evaluate the results of the control system design, students analyse the stability of the system in the time domain. Students who take systems dynamics and control courses should already know system modeling.

Intended Learning Outcomes (ILO)

ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
ILO. 8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to review control systems designed in accordance with dynamic system characteristics and can modify existing control systems with the aim of achieving control system objectives

Study Material

1. Laplace Transform
2. System dynamics modeling includes mechanical, electrical, thermal, fluid, mechanical-electrical systems
3. Basic control system
4. PID control design
5. Compensation system on control system
6. Analysis of system stability in time domain
7. Root locus
8. Digital control system

Prerequisite Course

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Main Library

Katsuhiko Ogata. (2010). Modern Control Engineering. New Delhi : Prentice Hall Inc.

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Support Libraries
1. Norman S Nise. (2011). Control Systems Engineering 4th edition. United States of America : John Wiley & Sons Inc. 2. Robert N Bateson. (2001). Introduction to Control Systems Technology. New Jersey: Prentice Hall.

COURSE: Machine Elements II	**COURSE CODE: TM201420**
	Semester 5/ 3 credits
Course Description	
Machine Element II study the components separately in the construction of the machine with a specific function of use, the engine elements II include the transmission and drive system	
Intended Learning Outcomes (ILO)	
ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
Course Learning Outcomes (CPMK)	

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Able to design gear and pulley transmission systems

Study Material

1. Transmission
2. Friction clutch & clutch
3. Friction disk
4. Gears & pulleys
5. Lubrication
6. Standards and codes

Prerequisite Course

1. Machine Element I

Main Library

1. Deutschman, Aaron D (1975). Machine Design, Theory and Practice: Collier Mac millan, International Edition, London

Support Libraries

1. Shigley, Joseph E (2001). Mechanical Engineering Design, 5th Edition: McGraw Hill
2. Sularso (2004). Basic Planning and Selection of Machine Elements : PT Pradya Paramita

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE : Manufacturing Process I	**COURSE CODE : TM201421**
	Semester 5/3 credits

Course Description

This manufacturing process I leads mechanical engineering students to recognize and understand product manufacturing processes commonly used in Engineethe manufacturing industry, determining and selecting manufacturing process parameters so that they are able to analyse and design product manufacturing processes. The focus of learning is on the machining process, forming, and powder metallurgy.

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

Able to understand the determination and selection of manufacturing process parameters so as to be able to analyse and design product manufacturing processes.

Study Material

1. Machining processes: lathe, milling, grinding and drilling processes.
2. Forming process: bending, forging, rolling, drawing, extrusion and sheet metal forming
3. Manufacture of products with powder metallurgy process.

Prerequisite Course

1. Metallurgy I

Main Library

1. Kalpakjian, Serope and Schmid, Steven R., (2014). "Manufacturing Engineering and Technology", 7th Ed, Prentice Hall.

Support Libraries

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1. Groover, Mikell P, (2013). "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", 5th Ed, Wiley.
2. Kalpakjian, Serope and Schmid, Steven R., (2008). "Manufacturing Processes for Engineering Materials", 5th Ed, Prentice Hall.
3. Schey, John A., (2000). "Introduction to Manufacturing Processes", 3rd Ed, McGraw-Hill.
4. E. Paul DeGarmo, J T. Black, Ronald A. Kohser., (2008). "Materials and Processes in Manufacturing", 10th Ed, Wiley.

COURSES: Numerical Method	**COURSE CODE: TM201422**
	Semester 5 / 3 credits

Course Description

The Numerical Method course is a compulsory subject that provides knowledge about solving mathematical problems in the field of mechanical engineering using a numerical approach, especially for complex problems that cannot be solved by an analytical approach. This course discusses differential equations, integration, regression and interpolation. In addition, students will also be given knowledge about the use of software assistance to solve complex problems.

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts
ILO. 8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to calculate numerical problems manually and practice solving problems in mechanical engineering using software assistance.

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Study Material

1. Analysis of errors (errors): measurement, source and propagation of errors
2. Ordinary differential equation
3. Partial differential equation
4. Linear equation
5. Non-linear equation
6. Interpolation
7. Regression
8. Integration

Prerequisite Course

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Main Library

1. Steven C. Chapra, Raymond. P. Chanale. (2015). Numerical Methods for Engineers. New York: McGraw-Hill Education.

Support Libraries

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	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Engineering Dynamics	**COURSE CODE: TM201423**
	Semester 5/ 3 credits

Course Description

This course discusses the basic concepts of engineering dynamics on particles, rigid bodies, and mechanisms. Students will learn to make mathematical models (freebody diagrams), formulate equations of motion, and analyse the motion of accelerated objects. In this course will also be discussed about; the principle of work and energy and its application to solve dynamic problems involving force, velocity, and displacement; the principles of impulse and momentum and their application to solve dynamic problems involving force, velocity, and time. In addition, material on collision mechanics and the application of engineering dynamics to mechanical engineering problems, such as balancing, flywheel design, gyroscope effects, and forces/moments on mechanisms is also discussed.

Intended Learning Outcomes (ILO)

ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Students are able to apply dynamics concepts and analyse practical mechanical engineering problems such as balancing, flywheel, gyroscope, and forces or moments on mechanisms.

Study Material

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1. Static force analysis on mechanism
2. d'Alembert Prinsip Principle
3. Inertial force on mechanism
4. Dynamic Analysis
5. Balancing for rotating mass and reciprocating mass
6. Gyroscope
7. Flywheel

Prerequisite Course

Kinematics

Main Library

1. Holowenko(1992), “Machinery Dynamics”, Erlangga
2. George Martin (1982), “Kinematics and Dynaics of Machine Second Martin”,McGraw-Hill

Support Library

1. Dan B. Marghitu (2005), “Kinematic Chains and Machine Components Design”, Elsevier

COURSE: Engineering Design	**COURSE CODE: TM201424**
	Semester 6 / 2 Credits

Course Description

Engineering Design is an implementation of the basic design courses. Students are expected not only to be able to master the theory but also to apply their knowledge in real terms. The machines that will be

designed and manufactured will be adapted to the needs of the local industry, for example, a garbage chopper, a cutting machine for certain foodstuffs, and others. In the learning process, students will be divided into groups and each group designs and builds a machine. In addition to applying theory during previous lectures, students are expected to practice working together in groups. The results of this lecture design are expected to support the empowerment of local wisdom of the surrounding community.

Intended Learning Outcomes (ILO)

ILO. 8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to design and manufacture certain machine elements (C6)

Study Material

1. Machine Element Design Task

Prerequisite Course

1. Machine Elements I and II

Main Library

1. Shigley, Joseph E (2001). Mechanical Engineering Design, 5th Edition, New York : McGraw Hill

Support Libraries

1. Sularso, Kiyosatsu Suga (2004). Basic Planning and Selection of Machine Elements. PT. Pradnya Paramita.
2. Khurmi, RS, JK Gupta (2005). Machine Design. Eurasia Publishing House (PVT.) LTD

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COURSE: Finite Element Method	**COURSE CODE: TM 201425**
	Semester 6/ 3 Credits

Course Description

This course is intended for students who will study the finite element method (FEM) or the finite element method from the point of view of engineering applications. Currently, many FEM users have limited theoretical foundations regarding this method which is actually very applicable. As a consequence, the use of commercial FEM programs is inaccurate and gives erroneous results. This course will overcome these limitations by introducing the theoretical basis behind this method in a format or presentation that is easier to understand. This course is open to students of mechanical engineering and other interested study programs.

This course is also open to professionals/industry who are interested in learning this method and plan to apply FEM knowledge in their workplace.

This course will introduce the use of commercial computer programs, be it ANSYS or ABAQUS (academic version) as well as several FEM computer programs that can be obtained freely, so that

Intended Learning Outcomes (ILO)

ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

1. Able to apply and analyse FEM engineering methods for mechanical system applications.

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Study Material

1. Introduction and concept
2. Mathematical concepts
3. Stress-strain analysis and design criteria
4. Uniaxial rod and truss
5. Beams and planes
6. 3D solid object
7. Modeling and analytical procedures
8. Design optimization

Prerequisite Course

1. Numerical Method

Main Library

1. Bathe, K.-J. (2014). Finite Element Procedures. SL: SN

Support Libraries

1. Liu, GR and Quek, SS (2003). The finite element method : a practical course. Oxford; Boston: Butterworth-Heinemann.
2. Saeed Moaveni (2020). Finite element analysis : theory and application with ANSYS. Hoboken, Nj: Pearson, Inc.
3. Robert Davis Cook (2003). Concepts and applications of finite element analysis. India: John Wiley & Sons (Asia.
4. Yang, TY (1986). Finite element structural analysis. Englewood Cliffs, NJ: Prentice-Hall.
5. https://academy.3ds.com/en/software/abaqus-student-edition (Download the student edition of the ABAQUS program)

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE : Energy Conversion Machine	**COURSE CODE: TM201426** Semester 6/ 3 Credits

Course Description

Energy Conversion Machines are widely applied in the industrial world such as tools used in power generation systems, which relate to the conversion of energy needed by an industry as well as daily needs. To convert an energy requires a tool or machine that can convert that energy. In this course, the learning material is focused on the principles and uses of energy conversion machines and non-conventional conversion machines. So that students can master the principles and their uses and be able to analyse the process of changing the energy produced.

Intended Learning Outcomes (ILO)

ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to calculate and analyse energy changes that occur in conventional and non-conventional energy conversion machines

Study Material

1. Internal Combustion Machine
2. Outdoor Combustion Machine
3. Machines – Fluid Machines
4. Cooling machine
5. Thermal Pump
6. Non-Conventional Energy Conversion Machine

7. Practice

Prerequisite Course

1. Thermodynamics II and Heat and Mass Transfer II

Main Library

1. Pudjanarsa A, Nursuhud D (2006), Energy Conversion Machine, Yogyakarta : Andi

Support Libraries

1. Arismunandar, W (1988), Piston Fuel Motor Starter, Bandung : ITB
2. Budiarso, Harinaldi (2015), Fluid Systems, Erlangga
3. Domkundwar, VM (2001), Course of Internal Combustion Engine, New Delhi : Dhanpat raid & Company
4. Heywood, John B (1988), Internal Combustion Engine Fundamentals, Singapore : McGraw-Hill
5. Stoecker, WF (1983), Refrigeration & Air Conditioning, USA : McGraw-Hill

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Manufacturing Process II	**COURSE CODE: : TM201427** Semester 6/3 credits

Course Description

Manufacturing process II leads mechanical engineering students to recognize and understand product manufacturing processes commonly used in the manufacturing industry, determine and select manufacturing process parameters so that they are able to analyse and design product manufacturing processes. The focus of learning is on non-conventional machining processes, welding processes, casting processes and polymers and their manufacturing processes,

Intended Learning Outcomes (ILO)

ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

Able to understand the determination and selection of manufacturing process parameters so as to be able to analyse and design product manufacturing processes.

Study Material

1. Non-conventional machining processes: Abrasive and Water Jet Machining (AJM and WJM), Electric Discharge Machining (EDM), Electrochemical Machining (ECM), Electrochemical Grinding (ECG), and Chemical Machining (CHM).

2. Welding process: Shield Metal Arc Welding (SMAW), Acetylene Gas Welding (AGW), Resistance Welding (RW), Brazing and Soldering (B&S), Tungsten Inert Gas (TIG), Submerge Arc Welding (SAW), Plasma Arc Welding (PAW)).
3. Polymers and their manufacturing process: Extrusion, Injection and Blow molding.
4. Casting process: Sand Casting, Centrifugal Casting, Die Casting, and Continuous Casting

Prerequisite Course

Manufacturing Process I

Main Library

1. Kalpakjian, Serope and Schmid, Steven R., (2014). "Manufacturing Engineering and Technology", 7th Ed, Prentice Hall.

Support Libraries

1. Groover, Mikell P, (2013). "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", 5th Ed, Wiley.
2. Kalpakjian, Serope and Schmid, Steven R, (2008). "Manufacturing Processes for Engineering Materials", 5th Ed, Prentice Hall.
3. Schey, John A., (2000). "Introduction to Manufacturing Processes", 3rd Ed, McGraw-Hill,
4. E. Paul DeGarmo, J T. Black, Ronald A. Kohser., (2008). "Materials and Processes in Manufacturing", 10th Ed, Wiley.

COURSES : Mechatronics	**COURSE CODE: TM201428**
	Semester 6/ 2 credits

Course Description

Mechatronics is a technology or engineering that combines technology about machinery, electronics, and informatics to design, manufacture, operate and maintain systems. In this course, students will learn about the basic concepts of mechatronics such as electronic components, number systems, digital systems. The output of this course is a big task by designing and making models or prototypes

Intended Learning Outcomes (ILO)

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ILO. 7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Students are able to design mechatronic systems and apply the latest control system concepts (microprocessor based) into mechatronic systems

Study Material

1. Semiconductors, diodes, transistors, operational amplifiers
2. number system
3. Binary mathematics
4. Boolean algebra
5. Analog and digital system
6. Data acquisition and conversion

Prerequisite Course

-

Main Library

Godfrey, Onwuboolu, “Mechatronics, Principles and Applications”, Elsevier

Support Library

1. Robert H. Bishop (2002), The Mechatronics Handbook, CRC Pres
2. Annalisa Milella, et al (2010). “Mechatronics System Applications”, InTech

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COURSES: Practical Work	**COURSE CODE: TM**
	Semester 7/ 2 credits
Course Description	
Practical work is a place for students to better understand, apply theory and real practice in the industrial world. In doing practical work students can practice professionally dealing with problems in the industry.	
Intended Learning Outcomes (ILO)	

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ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts

Course Learning Outcomes (CPMK)

1. Able to communicate with workers in the industry well and be able to compile reports on the results of practical work obtained in the field

Study Material

1.

Prerequisite Course

-

Main Library

Support Libraries

COURSE: Thesis Proposal	**COURSE CODE: TM**
	Semester 7 / 2 credits

Course Description

Thesis proposal is one of the requirements for the completion of studies in mechanical engineering, this thesis proposal contains the background, basic theory and research methods carried out.

Intended Learning Outcomes (ILO)

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ILO. 8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to compile a thesis proposal report in accordance with the correct scientific writing format

Study Material

Prerequisite Course

-

Main Library

Support Libraries

COURSE : Operations Management	**COURSE CODE : TM201429** Semester 7/3 credits

Course Description

This course aims to equip students with the ability to plan and manage a production system, the ability to evaluate and improve the performance of a production system, and the ability to get ideas for starting a business or production system, as well as designing a good production system.

Intended Learning Outcomes (ILO)

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ILO. 6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts.

Course Learning Outcomes (CPMK)

Able to manage factories so that all customer demands can be met with minimum total production costs and are able to evaluate and make improvements to a production system to obtain more optimal productivity performance.

Study Material

1. Introduction to production planning
2. Forecasting, Aggregate planning, Inventory Control
3. MRP, Sequencing and Scheduling, Lean Manufacturing, Quality Management
4. Introduction to New Business Design, Operation Strategy & Competitiveness, Strategic Management & Supply Chain
5. Product Design; Process Design; Job design & Work Measurement
6. Plant Layout and Project Management

Prerequisite Course

-

Main Library

1. Jay Heizer, Barry Render and Chuck Munson, (2016). “Operations Management: Sustainability and Supply Chain Management”, 12th Edition, Pearson Education Limited.

Support Libraries

1. Jay Heizer, Barry Render and Chuck Munson, (2017). “Principles of operations management sustainability and supply chain management” 10th Edition, Pearson Education Limited.
2. Chase, Aquilano, and Jacobs, (2009). “Operations and Supply Management”, 12th Edition, McGraw Hill.

3. Stevenson, William J, (2018). “Operations Management” 13th edition, McGraw-Hill.

COURSE: Mechanical Vibration	**COURSE CODE: TM201430**
	Semester 7/3 credits

Course Description

students will learn about mechanical vibrations in 1 DoF and 2 DoF systems. Students will learn about the basic concepts of vibration, mathematical modeling of vibration systems, formulating equations of motion, solving equations of motion to analyse the response of a vibration system. Various kinds of mechanical vibration conditions are discussed in this course, including the vibration response of an undamped and damped system under excitation-free conditions or by force with various kinds of excitation. Vibration

practicum on the rotating shaft is also given as material support. The goal is that students have the ability and experience to model and analyse mechanical vibration problems, especially in the field of mechanical engineering, as well as learn to think critically about its use in various other fields so that they are able to make the right decisions.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology.

Course Learning Outcomes (CPMK)

Students are able to model vibration systems, compose equations of motion, and choose a solution system that fits the type of vibration case, and analyse it.

Study Material

1. Modeling
2. Energy Method
3. Single degree of freedom vibration (free and submerged)
4. Forced Vibration
5. Two Degrees of Freedom Free Vibration
6. Practical Methods (Dukerley, Rayleigh)

Prerequisite Course

Engineering Dynamics

Main Library

1. Rao, Singiresu S. (2011), “Mechanical Vibrations”, 5th Edition, Prentice Hall

Support Library

1. Kelly, S. Graham (2011), “Mechanical Vibrations: Theory and Applications”, SI Edition, Cengage Learning
2. Timoshenko, S. (1990), "Vibration Problems in Engineering", Fifth Edition, John Wiley & Sons, Inc.

3. Leonard Meirovitch (1986), "Elements Of Vibration Analysis", International Edition, McGraw-Hill
4. Inman, DJ (2008), “Engineering Vibration”, 3rd Edition, Pearson Prentice Hall

COURSE : Electrical Power Engineering	**COURSE CODE: TM201431** Semester 7/ 3 Credits

Course Description

Mechanical Engineering knowledge cannot be separated from knowledge of electrical energy, especially in today's fully automated era. Electrical Power Engineering is designed to contain the basics of electric power and electronics, as well as an introduction to electrical machines. After taking this course, students understand the working principles of electrical equipment and are able to choose electrical equipment according to their use and are able to operate and maintain certain electrical equipment. The learning process is carried out in the lecture room and practicum in the laboratory.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Able to choose electric motors and generators according to operating conditions (C4)

Study Material

1. Introduction of power supplies and electrical loads
2. Basic electrical and magnetic circuits, transformers
3. Electromechanical basics
4. Direct current machine, synchronous machine, induction machine
5. Characteristics of work and its use
6. Selection, control, maintenance of motors and generators
7. Practice

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Prerequisite Course
1. Basic Physics I and II
Main Library
1. Zuhal (2000). "Basics of Electrical Engineering and Power Electronics", Jakarta: Publisher Gramedia Pustaka Utama.
Support Libraries
1. Wijaya, Mochtar (2001). Electrical Machine Basics. Jakarta : Bridge.

COURSE : Pumps and Compressors	**COURSE CODE: TM201501**
	Electives (Semester 7) / 3 Credits
Course Description	
The use of pumps and compressors is very much in the field of Mechanical Engineering. The use of pumps is for example the regional water company (PDAM) irrigation pumps, or certain liquid pumps in factories, while the use of compressors is for example for pneumatic systems in factories. The Pump and Compressor course discusses the basic principles of pumping, working principles, construction, installation, operation and maintenance of pumps and compressors. Students are expected to be able to choose a pump/compressor according to operating conditions and to design a pump/compressor installation in a simple pumping system. The lecture was held in the classroom and continued with the task of designing a particular pumping system	
Intended Learning Outcomes (ILO)	
ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts.
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions
Course Learning Outcomes (CPMK)	

Able to choose pump/compressor according to operating conditions (C4)

Study Material

1. The basic theory of displacement
2. Pump basic theory
3. Pump construction
4. Pump Head and NPSH
5. Pump installation and maintenance
6. Classification and basic theory of compressors
7. Vapor Compression
8. Compressor construction
9. Compressor installation, operation and maintenance

Prerequisite Course

1. Energy Conversion Machine with D as the minimum value

Main Library

1. Igor, J. Karassik, Joseph P. Messina, Paul Cooper, Charles C. Heald (2001). Pump Handbook, Third Edition. New York : McGraw Hill

Support Libraries

1. Sularso and Haruo Tahara (2000). Pumps and Compressors. Jakarta: Pradnya Paramita

Institut Teknologi Kalimantan	**SYLLABUS** **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE: Heat Exchanger	**COURSE CODE: TM201502**	
	Electives (Semester 7)/ 3 Credits	
Course Description		
This course discusses the concepts of conduction and convection heat transfer, construction of heat exchangers, configuration of heat exchangers (the arrangement of tubes), heat exchanger bulkheads, cells and tubes and the impurity factors that occur in heat exchangers, heat exchanger planning procedure. After taking this course, students are expected to understand the concepts of heat exchangers and their interrelationships and be able to apply them to the mechanical engineering field.		
Intended Outcomes Graduates (ILO)		
ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts.	
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions.	
Course Learning Outcomes (CPMK)		
Able to apply the basics of heat exchangers and analyse the performance of heat exchangers		
Study Material		

1. fundamentals of heat transfer & fluid mechanic theory
2. Basic design of heat exchanger
3. construction and components of heat exchangers
4. Performance of heat exchanger
5. heat exchanger maintenance

Prerequisite Course

1. Thermodynamics I and II, Heat and Mass Transfer I and II, Energy Conversion Machines

Main Library

1. Heat Exchanger Design handbook, Gulf publishing Company, 1968.

Support Libraries

1. Kem, D. Q (1983), Process Heat Transfer, McGraw Hill
2. TEMA (1983), Standard of tubular exchanger Manufacturers Association

COURSE : Matrix method for structural analysis	**COURSE CODE: TM201503**
	Electives (Semester 7)/3 credits

Course Description

The matrix method of structural analysis was developed in conjunction with the growing popularity of the use of automated computers for arithmetic operations. Structural analysis aims to determine whether it is deformation or stress that occurs in the structure, to what extent the characteristics of the relationship between force and deformation of the structural elements are known, and enforce the fulfillment of all compatibility and equilibrium conditions.

Intended Outcomes Graduates (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

Students are able to identify truss and beam cases and choose the right method to analyse them.

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Study Material

1. The big picture and procedure of the finite element method
2. The mathematical equations underlying the matrix method for structural analysis
3. Bar element for truss case
4. Beam element for frame case
5. Matrix code program for structural analysis using matlab
6. 2D and 3D Case Studies with software engineering

Prerequisite Course

Finite Element Method

Main Library

1. Ghali, Neville (1978), Structural Analysis, Erlangga
2. Amriyah Nasution (2009), Stiffness Matrix Method for Structural Analysis, ITB
3. Supartono, Boen (2007). Structural Analysis with Matrix Method, Universtas Indonesia Press

Support Library

1. Boumard, Lavaste, Resistance Des MAteriaux, Delagrave
2. Sofia (1998). Basic Principles of Finite Element Method, Tarumanegara University
3. Kosasih (2012), Theory and Application of Finite Element Method, Andi

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COURSE: Machine Tools	**COURSE CODE: TM201504**
	Electives (Semester 7)/3 credits

Course Description

Machine Tools know/understand the ability and quality of various production machine tools and know how to plan several components (parts) of both conventional and CNC machine tools.

Intended Learning Outcomes (ILO) charged to courses

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts.

Course Learning Outcomes (CPMK)

Able to analyse concepts, equipment, structures and cutting processes on machine tools

Study Material

1. Conventional and unconventional Machine tool structure
2. Machine tool cutting process
3. Machine tool control
4. CNC Machine

Prerequisite Course

Manufacturing Process I

Main Library

1. Manfred Weeks (1980). Handbook of machine tools:

Support Libraries

1. Koenigsberger, and J, Tlusty (1966) Machine Tools Structures :
2. N. Acmerkan D.Sc,(1969) Machine Tool design :Moscow MIR Publisher.

COURSE : Hydraulic and Pneumatic Systems	**COURSE CODE: TM201505** Electives (Semester 7)/ 3 credits

Course Description

Provide basics on the use of hydraulics & pneumatics power. The principle of transfer of energy is related to the characteristics of the fluid used. Characteristics of components, their operation and function. Understanding of hydraulics/pneumatics circuits and discrete control. Selection of equipment components from existing circuits. Utilization of hydraulics & pneumatics systems in industry, both advantages and disadvantages compared to other systems.

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts.
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

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Course Learning Outcomes (CPMK)

Able to apply the basic principles of hydraulics and pneumatics in their use in industry

Study Material

1. Hydraulic and pneumatic components
2. Hydraulic system
3. Pneumatic system

Prerequisite Course

Main Library

1. Esposito, A., (2000). Fluid Power with Applications, New York : Prentice Hall

Support Libraries

1. Watton, John, (1989). Fluid Power Systems, New York : Prentice Hall
2. Wolansky, William, (1990) Modern Hydraulics: New York : Maxwell

COURSE: Internal Combustion Engine	**COURSE CODE: TM201506**

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	Semester choice 7/3 credits

Course Description

Internal combustion engine is a course that focuses on studying gasoline and diesel engines in general. This internal combustion engine is widely applied, especially in the automotive industry and generating systems that use combustion engines. To analyse and plan its use, materials such as the working principle, the cycle that occurs during combustion, the resulting heat balance and the use of additional tools to increase the performance of the combustion engine are needed. So that students are expected to understand and analyse the theory. Learning activities in this course consist of lectures that discuss the theory and design tasks of a simple combustion engine.

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to calculate and analyse Otto and diesel cycles as well as the components of the motor so that it can modify the combustion system that occurs in the motor.

Study Material

1. Gasoline and diesel motors
2. Otto Cycle
3. Diesel Cycle
4. The ideal cycle of the combustion engine
5. Heat balance
6. The process of burning gasoline and diesel engines
7. Turbochargers and superchargers
8. Diesel motor simple design

Prerequisite Course

1. Energy Conversion Machine

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Main Library
1. Domkundwar, VM (2001), Course of Internal Combustion Engine, New Delhi : Dhanpat raid & Company
Support Libraries
1. Arismunandar, W (1988), Combustion Motor Starter, Bandung: ITB 2. Heywood, John B (1988), Internal Combustion Engine Fundamentals, Singapore : McGraw-Hill 3. Pulkrabek Willard W (1997), Engineering Fundamentals of the Internal Combustion Engine, Prentice Hall Inc

COURSE: Vehicle Engineering	**COURSE CODE: TM201507**
	Electives (Semester 7)/3 credits
Course Description	
Students are able to understand Vehicle Engineering in terms of construction and stability analysis. This course contains analysis of the forces on the wheels at rest, when they are moving, vehicle resistance forces, grip force, traction power, characteristics of the force/power – engine speed at various speed conditions, braking forces, brake construction, force turning, suspension, and vehicle stability problems while walking.	
Intended Learning Outcomes (ILO)	
ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in global, economic, environmental, and societal contexts
ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
Course Learning Outcomes (CPMK)	

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Students are able to design and analyse analytically and conduct studies on vehicle engineering, apply basic construction courses in the automotive field and technical analysis on vehicle dynamics and their propulsion which can then design them.

Study Material

1. The main components and materials of the vehicle
2. Vehicle body structure design concept
3. Fundamentals of vehicle dynamics
4. Vehicle tire characteristics
5. Chassis
6. Vehicle wind loads
7. Vehicle traction performance
8. Vehicle braking system
9. Vehicle direction behavior
10. Vehicle steering system
11. Passenger comfort

Prerequisite Course

Main Library

1. GILLESPIE (2001), Fundamentals of Vehicle Dynamics, Society of Automotive Engineers Inc, Butterwort Heinemann
2. I Nyoman Sutantra (2010), Automotive Technology Second Edition

Support Library

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1. Reimpel, et al. The Automotive Chassis: Engineering Principles

COURSE: Casting Engineering	**COURSE CODE: TM201508**
	Electives (Semester 7) / 3 credits

Course Description

Casting Engineering is a course that discusses the planning of a metal casting, with basic knowledge such as a basic study of castings, and materials from engineering materials courses one and two as the basis for planning the smelting process to pouring molten metal into molds. The molds that will be discussed in this course are sand and metal molds. Inspection of the casting results is needed to maximize the selling value based on an understanding of NDT (Non Destructive Test) before the material is finally traded.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology.

Course Learning Outcomes (CPMK)

1. Able to plan, produce small-scale castings

Study Material

1. Mold making process concept, Metal melting process, casting, casting freezing
2. Mold materials, design patterns, design molds, select casting processes, select materials, select kitchens and test the characteristics of molded materials and molten metal
3. Foundry concept

Prerequisite Course

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Main Library
1. Syria, Tata. (1980). Metal Casting Engineering, Jakarta : PT Pradiniya Paramita
Support Libraries
1. JS Campbell, (1995), Principles of manufacturing Materials And Process, Tata McGraw Hill, 2. PC Pandey and CK Singh, (2003), Production Engineering Sciences, Standard Publisher Ltd., 3. S Kalpakjian and SR Schmid, (2019), Manufacturing Process for Engineering Materials, Pearson education.

COURSE: Welding Engineering/Welding Technology	**COURSE CODE: TM 201509**
	Electives (Semester 7)/3 Credits
Course Description	
Welding is one of the most commonly used methods of joining materials in engineering applications. To produce a good and strong welded joint, the science and technology that underlies the welding process must be owned properly. This course is intended to introduce students to the basics of arc welding, weld joint design, welding metallurgy, welding quality assessment/testing. The topic of modern welding methods will also be introduced.	
Intended Learning Outcomes (ILO)	
ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology.
Course Learning Outcomes (CPMK)	
1. Know and understand the principles and factors that are important in welding. Have the physical and cognitive ability to follow welding certification.	

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Study Material
1. Definition, scope of welding, history and classification of welding processes. 2. Arc welding basics 3. Welding physics, welding arc characteristics, heat flow in welding 4. Power sources for welding / welding machines 5. Welded joint design principles and welding symbols 6. Welding metallurgy 7. Residual stress, welding defects, 8. Welding quality assessment 9. Modern welding techniques
Prerequisite Course
1. Engineering materials 2, Manufacturing Process 2
Main Library
1. Cary, HB (2011). Modern welding technology. Englewood Cliffs, NJ: Prentice-Hall.
Support Libraries
1. Goldak, JA and Mehdi Akhlaghi (2005). Computational welding mechanics. New York: Springer. 2. K Weman (2012). Welding processes handbook. Cambridge Woodhead. 3. Messler, RW (2005). Joining of materials and structures : from pragmatic process to enabling technology. New Delhi: Elsevier. 4. Sindo Kou (2020). Welding Metallurgy. SL: John Wiley.

COURSE: Fracture and Failure Mechanics	**COURSE CODE: TM 201510**
	Electives (semester 7) /3 Credits

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Course Description

Cracks and fractures are problems that are often faced in society, not only in the industrial sector but also in daily life. This problem is increasing in the modern era compared to the previous era because of the increasingly complex technology available. It is a must for engineering students, especially mechanical engineering to know and be familiar with the concept of cracking and failure of a material or component of a mechanical system. This course will teach students about the basic concepts of crack and fracture mechanics and the analytical methods used in the design of components to avoid component failure due to crack propagation and material fatigue.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology

Course Learning Outcomes (CPMK)

1. Able to identify and explain fatigue and material failure mechanisms and apply them to failure analysis, as well as calculate the service life of components in mechanical systems.

Study Material

1. Classification of fractures and failures (Fractures due to mechanical stress, fatigue fractures, fractures and cracks due to corrosion, Metal brittleness, weld cracks, work hardening cracks, thermal shock)
2. Fractures and material failure of fracture characteristics, strength of cohesion and Griffith theory
3. Fracture and failure of materials from metallographic aspects and notch effects
4. rate of release of strain energy
5. Plane strain toughness, Dugdale model, area of plasticity at the crack tip
6. Creep failure
7. Melting failure (fatigue)
8. Damage analysis, microstructural examination, fractography, fracture surface protection

Prerequisite Course

1. Metallurgy 2

Main Library

1. Anderson, TL (2017). Fracture mechanics : fundamentals and applications. Boca Raton: Crc Press/Taylor & Francis.

Support Libraries

1. Bannantine, JA, Comer, JJ and Handrock, JL (1990). Fundamentals of metal fatigue analysis. Englewood Cliffs, NJ: Prentice Hall.
2. Shackelford, JF (2016). Introduction to materials science for engineers. Boston UA: Pearson.
3. Smith, WF and Hashemi, J. (2019). Foundations of materials science and engineering. New York, Mrs: McGraw-Hill Education.

COURSE: Occupational Health and Safety (OHS)	**COURSE CODE:TM201511**
	Electives (Semester 7)/ 3 credits

Course Description

Occupational Health and Safety teaches regarding the meaning and terminology of security, causes of accidents, understanding of OHS, Regulations related to OHS, OHS Management System, Personal Protective Equipment, Contract Occupational Health and Safety Plan, Environmental Management System, OHS Construction Work, OHS Mechanical and Electrical Works, OHS Fire Fighting System, Inspection OHS Construction, Work Accident Analysis.

Intended Learning Outcomes (ILO)

ILO.5	An ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.

Course Learning Outcomes (CPMK)

Able to apply regulations, OHS management to minimize sources/potential accidents in the work area and environment

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Study Material
1. OHS Rules 2. OHS Management 3. Personal Protective Equipment (PPE) 4. Contract Occupational Health and Safety Plan construction 5. Environmental Management System 6. OHS Mechanical and electrical work 7. OHS Construction work 8. OHS Fire Extinguishing System 9. Work Accident Analysis
Prerequisite Course
Main Library
1. Kamala & Rao (2007). Environmental Engineering. New Delhi : McGraw Hill
Support Libraries
2. Gunawan (2009). Analysis of Recognizing Environmental Impacts. Yogyakarta : Gajah Mada University Press, 3. Anonymous (2008). K3 Guidelines: Ministry of Manpower

COURSE : Economics Engineering	**COURSE CODE : TM201512**

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	Electives (Semester 7)/3 credits

Course Description

This course discusses economic concepts and costs, changes in the value of money over time, various methods of technical economic analysis, single and multiple investment analysis, comparison of investment alternatives, capital recovery analysis, taxation for investment, depreciation, and the feasibility of public sector investments. It is expected that mechanical students are able to make decisions or analyse the feasibility of production projects or machine development using economic principles.

Intended Learning Outcomes (ILO)

ILO.5	An ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.

Course Learning Outcomes (CPMK)

Able to apply the basic concepts of Engineering Economics as part of the decision-making process in analyzing equipment replacement or product development by considering the economic impact of an engineering application problem in an industry.

Study Material

1. Role of engineering economy in the decision making process
2. Derivation of engineering economy factors and their use
3. Nominal and effective interest rates and continuous compounding
4. Use of multiple factors
5. Present worth and capitalized cost evaluation
6. Equivalent uniform annual worth evaluation
7. Rate of return computation
8. Benefit/Cost ratio evaluation
9. Replacement analysis
10. Inflation, cost estimation and indirect cost allocation
11. Depreciation and depletion models
12. Break-even analysis and payback period
13. Minimum attractive rate of return
14. Sensitivity analysis and expected value decisions

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Prerequisite Course	
Main Library	
1. Sharma, Kal Renganathan, (2015). "An introduction to engineering economics", Momentum Press, 2. David L. Whitman, Ronald E. Terry, (2012). "Fundamentals of Engineering Economics and Decisions", Morgan & Claypool Publishers. 3. Chan S. Park, (2012). "Fundamentals of Engineering Economics", Third Edition, Pearson Education,	
Support Libraries	
1. Chan S. Park, (2006). "Contemporary Engineering Economics", Prentice Hall. 2. Yates, J. K, (2017). "Engineering Economics", CRC Press. 3. Sharma, Kal Renganathan, (2015). "Practical applications of engineering economics", Momentum Press.	
COURSE: Material and Process Selection	**COURSE CODE: TM201513**
	Electives (Semester 7) / 3 credits
Course Description	
Selection of materials and processes is a course that discusses advanced materials and their application in the environment around us. Basic courses such as engineering materials are needed to serve as a benchmark for initial understanding. Advanced phase diagram analysis is required when discussing advanced metals.	
Intended Learning Outcomes (ILO)	
ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
Course Learning Outcomes (CPMK)	
Able to analyse and complete the requirements of a material against the needs of the system/tools required according to applicable standards.	

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Study Material
1. Process and design criteria 2. Design Type 3. Material selection principle, material index 4. Material chart 5. Classification and process flow diagrams 6. Application of materials (static structure, fatigue resistance, corrosion resistance, high temperature, wear resistance) 7. brittle material 8. Biomaterials
Prerequisite Course
Main Library
1. Surdia, Tata (1980) Metal Casting Engineering, Jakarta : PT Pradiniya Paramita.
Support Libraries
2. William D. Callister, J. (2006). Materials Science and Engineering: An Introduction. Asia: John Wiley & Sons, Inc. 3. JS Campbell (1995.) Principles of manufacturing Materials And Process, Tata McGraw Hill, 4. PC Pandey and CK Singh (2003). Production Engineering Sciences, Standard Publisher Ltd., 5. S Kalpakjian and SR Schmid (2019). Manufacturing Process for Engineering Materials, Pearson education.

COURSES : Energy Audit	**COURSE CODE: TM201520**
	Electives (Semester 8)/ 3 credits
Course Description	

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This Energy Audit course is a course that discusses calculating the amount of energy consumption in buildings and knowing energy saving opportunities. In this course, the materials are focused on the principles of conducting energy audits, especially on energy audits of buildings including offices, hotels, shops/shopping centers, hospitals, apartments and residences based on applicable Indonesia's National Standard (SNI) standards, so that students are able to perform energy consumption analysis on buildings, identify energy-saving opportunities and apply them in daily life thereby increasing energy efficiency while reducing operating costs.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to master the technical implementation and analyse building energy audits for energy saving opportunities

Study Material

1. Basic Energy Audit
2. Energy Accounting and Analysis
3. Energy Economy
4. Instrumentation Measuring Instruments
5. Building Envelope Audit
6. HVAC audit
7. Electrical System Audit
8. Energy Saving Estimation Method

1. *Energy Auditing Basics*
2. *Energy Accounting and Analysis*
3. *Energy Economics*
4. *Building Envelope Audit*
5. *Instrumentation*
6. *Electrical System Audit*

7. *Method for Estimating Energy Saving*

Prerequisite Course

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Main Library

1. Albert Thumann, William J. Younger, Terry Niehus (2010), Handbook of Energy Audits, Eighth Edition, The Fairmont Press

Support Libraries

1. Moncef Krarti (2010), Energy Audit of Building Systems: An Engineering Approach, Second Edition, CRC Press, Taylor & Francis Group

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COURSE: Robot Mechanism	**COURSE CODE: TM201521**
	Electives (Semester 8)/3 credits

Course Description

students will be provided with the basic concepts of robotics in terms of mechanisms. From the mechanical side, kinematics and dynamics are considered to analyse the movement

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to analyse the movement of the robot position through kinematic and dynamic analysis on several types of robots

Study Material

1. Types of robots and their development
2. Kinematic analysis in the form of position and displacement (degrees of freedom of position coordinate
3. Robotic arm dynamics analysis
4. Matrix jacobian and singularity (type of singularity in terms of matrix jacobian)
5. Robot design (screw theory, type of constraint in connection)
6. computational (computational analysis of position calculations on displacement)

Prerequisite Course

Engineering Dynamics, Mechatronics

Main Library

1. John J. Craig, (1989), Introduction to Robotics, Addison-Wesley
2. Jorge Angeles (2002), Fundamentals of Robotic Mechanical Systems, Theory, Methods, and Algorithms second Edition, Springer
3. Spong (2004), Robot Dynamics and Control Second Edition

Support Libraries

1. Horacio Martínez‐Alfaro(2011) , Advances In Mechatronics , InTech
2. Sam Cubero (2007), Industrial Robotics Theory, Modeling and Control, Pro Literature Verla
3. Siegwart, Nourbakhsh, (2004), Introduction to Autonomous Mobile Robot, The MIT Press

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COURSE : Mechanical System Design of Buildings	**COURSE CODE: TM201522**
	Electives (Semester 8)/3 credits

Course Description

This course provides students with basic understanding and competence in utility design, especially in the mechanical field of buildings, which includes ventilation and air conditioning systems, plumbing, fire protection, and sewage treatment, as well as transportation within buildings.

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Capable of designing a utility system for a high-rise building.

Study Material

1. Building mechanical system design
2. Heating Ventilation and Air Conditioning (HVAC)
3. Plumbing
4. fire protection
5. Dirty water treatment
6. Indoor Transportation

Prerequisite Course

Main Library

1. Hall, Greeno (2011). Building Services Handbook Incorporating Current Building and Construction Regulations 6th Edition, Elsevier
2. Walter, et al (2015). Mechanical and Electrical Equipment for Building 12th Edition, Willey
3. Stein, et al. (2006). Mechanical and Electrical Equipment for Building, John Wiley and Sons

Support Libraries

1. Department of Public Works, Building Expert Team Guidelines
2. Department of Public Works, Guidelines for Building Functions Worthiness Certificates
3. Department of Public Works, Technical Guidelines for Building Permits
4. Bhatia. The MEP Design of Building Services, CED Engineering
5. MEP Guide for Planning and Scheduling, Planning Engineer
6. Sayogo, et al (2014). Explanation of PUIL (General Electrical Installation Requirements) 2011, HIMAPUIL

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

COURSE : Computational Fluid Dynamics	**COURSE CODE: TM201523** Electives (Semester 8) / 3 Credits
Course Description	
Advances in computing technology are now pushing for the solution of certain problems with numerical simulations. Flow phenomena occurring, for example in pipes or around flanges, can be approximated by numerical solutions. The Computational Fluid Dynamics course discusses the basic principles of Computational Fluid Dynamics, introduction to fluid dynamics regulatory equations, and numerical/computational solutions. Students are expected to be able to solve simple flow problems using numerical simulation after completing this course. Learning will be carried out in the classroom and followed by programming exercises.	
Intended Learning Outcomes (ILO)	
ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions
Course Learning Outcomes (CPMK)	
Able to simulate simple flow problems with numerical simulation (C3)	
Study Material	

1. Fundamentals of computational fluid dynamics
2. Rule equations in fluid dynamics
3. Numerical Simulation using Software

Prerequisite Course

1. Fluid Mechanics I and II with a minimum value of D
2. Numerical Method with a minimum value of D

Main Library

1. Anderson, John D Jr. (1995). Computational Fluid Dynamics The Basics with Applications. New York : McGraw Hill

Support Libraries

1. -

COURSE : Steam Power Generation System	**COURSE CODE: TM201524**
	Semester 8 / 3 Credits

Course Description

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Steam Power Generation System is a course designed to learn the basics of Steam Power Generation (PLTU). This course studies the Rankine Cycle, the main components of PLTU, and thermal equilibrium in PLTU and each of its main components. After undergoing this course, students are expected to understand the working principle of PLTU and be able to calculate the thermal balance in the system so that they are able to find optimal system working conditions. Learning activities are carried out with lectures in classrooms and independent exercises.

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to analyse thermal equilibrium in Steam Power Plant (C4)

Study Material

1. Cycles and main components of PLTU
2. Heat balance at PLTU
3. Introduction of Geothermal Power Plant

Prerequisite Course

1. Thermodynamics I and II with a minimum value of D

Main Library

1. Black and Veatch (1996). Power Plant Engineering. New York : Springer

Support Libraries

1. -

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COURSE: Heavy Equipment	**COURSE CODE: TM201525**
	Electives (Semester 8)/ 3 Credits

Course Description

The Heavy Equipment course studies the types and functions of heavy equipment as well as their suitability for work (material, workload and work area) calculation of capacity, number of units, heavy equipment cycles and costs so as to be able to make production management of heavy equipment work.

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	an ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to apply heavy equipment product management for each type of material in completing projects

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Study Material
1. material physical properties 2. Functions and Applications of heavy equipment and attachments 3. Load and Power Analysis 4. Land Clearing Job 5. Earth Moving Jobs 6. Owning and operating costs
Prerequisite Course
1. Does not have prerequisite courses
Main Library
1. Kadek Ade Suryawan (2019). Heavy Equipment Management : Deeppublish
Support Libraries
2. Rochmanhadi (1985) Calculation of Work Implementation Using Heavy Equipment. Jakarta: Department of Public Works 3. Anonymous (2012). Application and Production of Heavy Equipment: PT United Tractor Tbk

COURSE: Corrosion/Corrosion	**COURSE CODE: TM 201526**
	Electives (Semester 8)/3 Credits
Course Description	

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If you have ever seen a rusty vehicle body, leaking pipelines, damaged supporting construction and buildings, then the effects of corrosion are taking place on these objects. This course will teach why metals corrode, environmental effects on material degradation, cost consequences caused by corrosion, and corrosion protection and control measures. This course is intended for students and professionals who need corrosion knowledge in their business activities.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to apply the concept of corrosion control and corrosion rate analysis.

Study Material

1. Definition, understanding
2. Understanding of terminology in the corrosion process includes understanding anode, cathode, electrolyte, conductor, redox reactions, corrosion aspects (materials and the environment), reaction aspects in terms of thermodynamics and electrochemistry, standard potential, polarization, passivation. Pourbaix charts.
3. Types of corrosion, mechanisms and preventive measures.
4. High temperature corrosion and Ellingham diagram.
5. Corrosive media and corrosion resistant materials.
6. Corrosion control, cathodic protection principle.
7. The practice of measuring the potential of an electrode, the current flowing between the two electrodes, the resistance of the electrolyte.

Prerequisite Course

Main Library

1. Fontana, Mars G./Green, Nobert D., “Corrosion Engineering”, Mac Graw Hill International Book Company.

Support Libraries

1. Jones, Denny A., “Principles and Prevention of Corrosion”, Mac Millan Publishing Company, a division of MacMillan, Inc.
2. Uhlig, Herbert H., “Corrosion and Corrosion Control” an Introduction to Corrosion Science and Engineering, second edition, John Wiley & Sons, Inc.

COURSE: New and Renewable Energy	**COURSE CODE: TM201527**
	Electives (Semester 8)/ 3 credits

Course Description

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New and Renewable Energy Courses are courses that study alternative energy used to replace existing conventional energy. These innovations from new and renewable energy have been widely applied for small to large scale. This course will discuss how to utilize existing renewable energy sources according to regional potential so that they can be utilized such as power generation, fuel substitution and food security. To achieve this capability, the learning method is used by discussing the availability of energy resources and their uses which include conversion and storage technologies and providing a project to create a simple model of energy utilization.

Intended Learning Outcomes (ILO)

ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts
ILO.8	an ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to analyse the potential of new renewable energy sources so as to be able to design new renewable energy conversion technology (C4).

Study Material

1. Introduction to New and Renewable Energy
2. NRE Conversion Technology
3. NRE Storage Technology
4. EBT Economic Studies
5. EBT Design Project

Prerequisite Course

1.	Energy Conversion Machine
Main Library	
1.	Paul Breeze, et al. (2009), Renewable Energy Focus Handbook, Elsevier Academic Press.
Support Libraries	
1.	BPPT, (2020), Indonesia Energy Outlook 2020, PPIPE BPPT.
2.	Mathew Sathyajit, (2006), Wind Energy Fundamentals, Resource Analysis and Economics, Springer.

COURSE: Cooling Engineering	**COURSE CODE: TM201528**
	Electives (Semester 8)/ 3 credits
Course Description	
Cooling Techniques are always used in air conditioning systems or cooling systems both on a household scale and on an industrial scale. In designing and analyzing the air cooling system, students are required to know the general concept, the components of the refrigeration machine, the use of psychometric diagrams, the analysis of the heat load and the type of refrigerant to be used. Learning activities consist of lectures that discuss the theory and tasks of cooling system planning.	
Intended Learning Outcomes (ILO)	
ILO.6	An ability to identify, formulate, and solve mechanical engineering problems by applying principles of engineering, science, and mathematics in mechanical systems in in global, economic, environmental, and societal contexts

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ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to calculate and analyse loading to determine cooling capacity and performance coefficient on cooling machines

Study Material

1. Cooling General Concept
2. Cooling Machine Components
3. Air properties
4. Psychometric Diagram
5. Air Conditioning System
6. Calorific Load
7. Engine Cooling Cycle
8. Refrigerant
9. Standard Cycle and Effects of Operating Conditions

Prerequisite Course

1. Energy Conversion Machine

Main Library

1. Stoecker, WF (1983), Refrigeration & Air Conditioning, USA : McGraw-Hill

Support Libraries

1. Pita Edward G (2002), Air Conditioning Principles and Systems An Energy Approach, Prentice Hall
2. Grondzik Walter T (2007), Air Conditioning Systems Design Manual 2th Ed, Butterworth-Heinemann
3. Jones WP (2001), Air Conditioning Engineering 5th Ed, Butterworth-Heinemann

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COURSE : Heat Treatment	**COURSE CODE: TM201529** Electives (Semester 8)/ 3 Credits
Course Description	
This course discusses the concepts of crystallization, material properties, metal alloy elements, heat treatment methods, heating and cooling methods so that students are able to analyse the heat treatment process and hardenability (surface engineering) on metals so that they are able to choose and carry out the heat treatment process appropriately according to their needs. materials used for certain applications.	
Intended Learning Outcomes (ILO)	
ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions
Course Learning Outcomes (CPMK)	
Able to analyse material properties and apply heat treatment methods to metals	
Study Material	

	SYLLABUS **MECHANICAL ENGINEERING STUDY PROGRAM** **Academic year 2020 - 2025**	No. Dock. : Issued On : 01/04/2020 No. Revision : 00 Case : 2/2

1. Crystallization
2. Material Properties
3. Metal Alloy Element
4. Heat Treatment Method
5. Heating and Cooling

Prerequisite Course

1. Engineering Materials I and II

Main Library

1. George E.Totten,(2006), Steel Heat Treatment – Metallurgy and Technologies, CRC

Support Libraries

1. Karl-Erik Thelning (Auth.) (1967), Steel and its Heat Treatment. Bofors Handboo, Butterworth & Co Publishers Ltd.

COURSE: Alloy Metal	**COURSE CODE: TM201530**
	Electives (Semester 8) / 3 Credits

Course Description

Alloy Metals is a course that discusses calculations related to a binary alloy phase diagram, ternary diagram. Microstructural analysis of a low, medium and high alloy metal. Each type of metal alloy has a phase solubility that can be observed and analysed for the possibilities that may occur as a result of the manufacturing process. The mechanical properties of a material are related to the condition of its isomorphic diagram.

Intended Learning Outcomes (ILO)

ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to relate from an alloy formation process in the form of scientific articles and solve the problem of the effect of adding an element to an alloy metal

Study Material

1. Impurities in Solid
2. Phase Diagram
3. Solubility limit
4. Phases
5. Microstructure
6. Phase Equilibria
7. One-component phase diagrams
8. binary isomorphous system
9. interpretation of phase diagrams
10. Development of microstructure in isomorphous
11. Mechanical Properties Isomorphous alloy

Prerequisite Course

1. Engineering Materials II

Main Library

1. Avner, Sidney H (19870, Introduction to Physical Metallurgy, Second edition, Tokyo: McGraw Hill International Book Company

Support Libraries

1. Astm, E. (2015) Standard practice for microetching metals and alloys. ASTM International West Conshohocken, PA.
2. Callister, William D. Jr. (2007). Materials Science and Engineering, John Wiley & Sins Inc., New York,
3. Ho, PS, Wang, G., Ding, M., Zhao, J.-H. & Dai, X (2004) Reliability issues for flip-chip packages. Microelectronics Reliability, 44(5), 719-737.

COURSE : Maintenance Management and Engineering	**COURSE CODE: TM201531**
	Choice (VIII)/3

Course Description

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Maintenance Management and Engineering is a course that will teach the understanding of reliability theory and its application in the field. Giving students the ability to develop maintenance models, design and schedule maintenance both system and machine maintenance as well as diagnosis of damage and possible ways of repair

Intended Learning Outcomes (ILO)

ILO.5	an ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.
ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

Course Learning Outcomes (CPMK)

Able to apply the principles of maintenance, planning and scheduling appropriately

Study Material

1. Preventive, Predictive, Corrective Maintenance (PM, PdM, CM) maintenance functions and free maintenance
2. Planning and scheduling
3. Measuring tools in condition monitoring (vibration, lubricant analysis, NDT). Principle of measurement and interpretation of measurement results.
4. MTBF principles, reliability, availability and maintainability of equipment and componentsRC
5. Methods and implementation of RCM, TPM, RBI in industry.
6. Evaluation of damage to equipment and components (RCFA & FMEA) performance of maintenance functions based on KPI and identify potential problems. Miss alignment
7. Vibration diagnosis such as unbalance, misalignment, bearing fault diagnosis, gearmess frequency, loosen component, crankshaft.
8. Alignment method, balancing method.
9. Cathodic protection for stationary equipment.Ericsson cycle

Prerequisite Course

1. Does not have prerequisite courses

Main Library

1. Wireman Terry (1991). Total Productive Maintenance: Industrial Press, Inc.

Support Libraries

2. Beling, Charles E (1997). Reliability and Maintainability Engineering, International Edition, McGraw-Hill.
3. Ireson, W. Grant, Coombs, Clyde F., Moss, Richard Y (1995). Handbook of Reliability Engineering and Management. Second edition: McGraw-Hill, Sydney, Tokyo, Toronto.

COURSE: Operations Research	**COURSE CODE: TM201532**
	Electives (Semester 8)/3 credits

Course Description

This course provides knowledge of quantitative techniques for decision making which are interdisciplinary from applied mathematics and formal science that use models, such as mathematical models, statistics, and algorithms to obtain optimal values from a complex problem. Operations research can be used to find the optimal value (profit, raw materials, resources, assembly line performance, production, performance etc.) or minimal value (loss, risk, cost, etc.) of an objective function. Operations research aims to help management achieve its goals through a scientific process.

Intended Learning Outcomes (ILO)

1. ILO.5	an ability to perform life-long learning and apply new knowledge as needed using appropriate learning strategies.
2. ILO.7	An ability to model, analyse, design, and realize physical systems, components or processes using appropriate materials by utilizing information technology
3. ILO.8	An ability to develop and conduct experiment, analyse and interpret data, and use engineering judgment to draw conclusions

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Course Learning Outcomes (CPMK)

Able to make decisions using scientific quantitative techniques with various existing operations research methods so that they can be applied in mechanical engineering applications such as how to find the optimal value from profit, raw materials, resources, assembly line performance, production, engine performance, fuel efficiency and others .

Study Material

1. Decision-making theory.
2. Linear programming, graphical solution, simplex method, sensitivity, transport and assignment programming.
3. Network model, integer program and goal program.
4. Dynamic programming, queuing theory and simulation

Prerequisite Course

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Main Library

1. Hamdy A. Taha (2017). “Operations Research: An Introduction” 10th Edition, Pearson Education Limited.
2. Frederick S. Hillier, Gerald J. Lieberman (2015). “Introduction to Operations Research”, McGraw-Hill Education.

Support Libraries

1. Michael W. Carter, Camille C. Price, Ghaith Rabadi (2019). “Operations Research: A Practical Approach”, Second Edition, CRC Press.
2. Ronald L. Rardin, (2015). “Optimization in Operations Research”, Second Edition, Pearson Education Limited.
3. Raúl Poler, Josefa Mula, Manuel Díaz-Madroñero (2014). “Operations Research Problems: Statements and Solutions”, Springer-Verlag London.