# Master of Engineering in Mechanical Engineering

1. **Curriculum Title**

   Master of Engineering in Mechanical Engineering

2. **Degree Title**

   Master of Engineering (Mechanical Engineering)

3. **Applicant' Qualifications**

   3.1. **Plan A1**

   **3.1.1.** The applicant must hold a bachelor's degree in Mechanical engineering with a cumulative GPA of 3.00 or higher (out of 4.0).

   3.2. **Plan A2**

   **3.2.1.** The applicant must hold a bachelor's degree in Mechanical engineering with a cumulative GPA of 2.50 or higher (out of 4.0).

   **3.2.2.** The applicant must hold a bachelor's degree in Mechanical engineering with a cumulative GPA of less than 2.50 (out of 4.0) and have at least one year of relevant research or work experience.

   **3.2.3.** The applicant must hold a bachelor's degree in science or a related field that is accepted by the program committee and have a cumulative GPA of 2.75 or higher.

4. **Academic System**

   An academic year is divided into 2 semesters. Each semester consists of 16 weeks.

5. **Period of Study**

   The maximum period of study to complete the program is 4 academic years.

6. **Registration**

   The student must enroll in courses and/or register for a thesis totaling at least 6 credits but not more than 15 credits per semester.

7. **Graduation Requirements**

   To graduate, students must meet the following minimum requirements:

   7.1. **Plan A1**

   **7.1.1.** Thirty-six credits of thesis work and passing a thesis defense.

   **7.1.2.** Approval of the thesis by the external examiner and the thesis committee.

   **7.1.3.** At least one paper on thesis findings has been accepted for publication in a national or international journal and at least one paper has been accepted for publication in national or international conference proceedings.

   **7.1.4.** Have satisfied the English proficiency requirement as specified by the PSU Executive Committee.

   7.2. **Plan A2**

   **7.2.1.** Eighteen credits of taught courses required by the curriculum with an accumulative GPA of at least 3.00.

   **7.2.2.** Eighteen credits of thesis work and passing a thesis defense.

   **7.2.3.** Approval of the thesis by the external examiner and the thesis committee.

   **7.2.4.** At least one paper on thesis findings has been accepted for publication in a national or international journal or at least two papers has been accepted for publication in national or international conference proceedings.

7.2.5. Have satisfied the English proficiency requirement as specified by the PSU Executive Committee.

**7.3. Total Credits requirement**

A total of 36 credits is required for completion of the program.

**7.4. Structure and Components**

**7.4.1. Plan A1**

| | | |
|---|---|---|
| **Core Courses** | **1*** | **Credit** |
| Seminar | 1* | Credit |
| **Master's Thesis** | **36** | **Credits** |
| **Total** | **36** | **Credits** |

**7.4.2. Plan A2**

| | | |
|---|---|---|
| **Core Courses** | **18+1*** | **Credit** |
| Seminar | 1* | Credit |
| Compulsory Courses | 6 | Credits |
| Approved Elective Courses | 3 | Credits |
| Free Elective Courses | 6 | Credits |
| **Master's Thesis** | **18** | **Credits** |
| **Total** | **36** | **Credits** |

* No credit will be granted. Evaluation will be only S/U.

**7.5. Course Coding System**

Subject code consists of 6 numbers: 215-6XY

7.5.1. 215 indicates subjects in Mechanical Engineering Program.

7.5.2. 6 indicates the graduate program.

7.5.3. X indicates the subject group.

7.5.4. Y indicates the subject order.

**7.6. Credit Coding System**

Credits code consists of 4 numbers: A(B-C-D)

7.6.1. A indicates the credits.

7.6.2. B indicates the lecture hours.

7.6.3. C indicates the practice hours.

7.6.4. D indicates the self study hours.

**7.7. List of courses in the curriculum**

**7.7.1. Plan A1**

**Seminar, 1 credit***

| | | |
|---|---|---|
| 215-601 | Seminar in Mechanical Engineering | 1* (0-2-1) |

* No credit will be granted. Evaluation will be only S/U.

**Master's Thesis, 36 credits**

| | | |
|---|---|---|
| 215-691 | Thesis | 36(0-108-0) |

**7.7.2. Plan A2**

**Seminar, 1 credit***

| | | |
|---|---|---|
| 215-601 | Seminar in Mechanical Engineering | 1* (0-2-1) |

* No credit will be granted. Evaluation will be only S/U.

**Master's Thesis, 18 credits**

| | | |
|---|---|---|
| 215-692 | Thesis | 18(0- 54-0) |

**Compulsory Courses, 6 credits**

| | | |
|---|---|---|
| 215-613 | Mathematical Methods in Engineering | 3(3-0-6) |
| 215-614 | Research Methodology | 3(3-0-6) |

**Approved Elective Courses, 3 credits from the following list:**

| | | |
|---|---|---|
| 215-612 | Finite Element Method | 3(3-0-6) |
| 215-653 | Computational Fluid Dynamics | 3(3-0-6) |
| 215-648 | System Optimization | 3(3-0-6) |

**Free Elective Courses, 9 credits from the following list:**

**Basic Engineering**

| | | |
|---|---|---|
| 215-611 | Theory of Engineering Experimentation | 3(3-0-6) |

**Applied Mechanics**

| | | |
|---|---|---|
| 215-621 | Linear System Analysis | 3(3-0-6) |
| 215-622 | Control Systems | 3(3-0-6) |
| 215-623 | Fluid Power Automation | 3(3-0-6) |
| 215-624 | Sound and Acoustics | 3(3-0-6) |
| 215-625 | System Modeling and Simulation | 3(2-2-5) |
| 215-626 | Vibration of Discretized Systems | 3(3-0-6) |
| 215-627 | Vibration of Continuous Systems | 3(3-0-6) |
| 215-628 | Matrix Methods in Analysis of Mechanisms | 3(3-0-6) |
| 215-629 | Introduction to CAD/CAM | 3(3-0-6) |

**Solid Mechanics**

| | | |
|---|---|---|
| 215-631 | Theory of Elasticity | 3(3-0-6) |
| 215-632 | Theory of Plasticity | 3(3-0-6) |
| 216-633 | Fracture Mechanics | 3(3-0-6) |
| 215-634 | Experimental Stress Analysis | 3(3-0-6) |

**Heat Transfer/Thermodynamics**

| | | |
|---|---|---|
| 215-641 | Advanced Thermodynamics | 3(3-0-6) |
| 215-642 | Heat Conduction and Thermal Radiation | 3(3-0-6) |
| 215-643 | Heat Convection | 3(3-0-6) |
| 215-644 | Thermal System Design | 3(3-0-6) |
| 215-645 | Advanced Refrigeration and Air Conditioning | 3(3-0-6) |
| 215-646 | Advanced Power Plant Engineering | 3(3-0-6) |
| 215-647 | Gas Turbine and Application | 3(3-0-6) |

**Fluid Mechanics**

| | | |
|---|---|---|
| 215-651 | Advanced Fluid Mechanics | 3(3-0-6) |
| 215-652 | Gas Dynamics | 3(3-0-6) |
| 215-654 | Multiphase Flow | 3(3-0-6) |
| 215-655 | Viscous Flow | 3(3-0-6) |
| 215-656 | Turbulent Flow | 3(3-0-6) |
| 215-657 | Aerosol Science and Engineering | 3(3-0-6) |

**Energy**

| | | |
|---|---|---|
| 215-661 | Energy Resources and Energy Conversion I | 3(3-0-6) |
| 215-662 | Thermal Energy Analysis | 3(3-0-6) |
| 215-663 | Energy Management in Buildings | 3(3-0-6) |
| 215-664 | Energy Management and Policy | 3(3-0-6) |
| 215-665 | Energy from Biomass and Conversion | 3(3-0-6) |
| 215-666 | Combustion | 3(3-0-6) |
| 215-667 | Theory of Drying | 3(3-0-6) |
| 215-668 | Energy Resources and Energy Conversion II | 3(3-0-6) |

**Computer Applications**

| | | |
|---|---|---|
| 215-671 | Expert Systems | 3(3-0-6) |
| 215-672 | Principles of Robotics | 3(3-0-6) |
| 215-673 | Design of Electromechanical Systems | 3(3-0-6) |
| 215-674 | Robot Control | 3(3-0-6) |
| 215-675 | Programming of System Modeling and Simulation | 3(2-2-5) |

**Advanced Topics**

| | | |
|---|---|---|
| 215-681 | Advanced Topics in Mechanical Engineering I | 3(3-0-6) |
| 215-682 | Advanced Topics in Mechanical Engineering II | 3(3-0-6) |
| 215-683 | Advanced Topics in Mechanical Engineering III | 3(2-2-5) |
| 215-684 | Advanced Topics in Mechanical Engineering IV | 3(2-2-5) |

## 7.8. Study Plan

### 7.8.1. Plan A1

**1st year: 1st semester**

| | | | |
|---|---|---|---|
| 215-601 | Seminar in Mechanical Engineering | 1* | Credit |
| 215-691 | Thesis | 9 | Credits |

**1st year: 2nd semester**

| | | | |
|---|---|---|---|
| 215-691 | Thesis | 9 | Credits |

**2nd year: 1st semester**

| | | | |
|---|---|---|---|
| 215-691 | Thesis | 9 | Credits |

**2nd year: 2nd semester**

| | | | |
|---|---|---|---|
| 215-691 | Thesis | 9 | Credits |
| | **Total** | 36 | Credits |

**7.8.2. Plan A2**

**1st year: 1st semester**

| | | | |
|---|---|---|---|
| 215-601 | Seminar in Mechanical Engineering | 1* | Credit |
| 215-613 | Mathematical Methods in Engineering | 3 | Credits |
| 215-614 | Research Methodology | 3 | Credits |
| ..... | Approved or Free Elective Courses | 3 | Credits |

**1st year: 2nd semester**

| | | | |
|---|---|---|---|
| 215-692 | Thesis | 3 | Credits |
| ..... | Approved or Free Elective Courses | 6 | Credits |

**2nd year: 1st semester**

| | | | |
|---|---|---|---|
| 215-692 | Thesis | 6 | Credits |
| ..... | Approved or Free Elective Courses | 3 | Credits |

**2nd year: 2nd semester**

| | | | |
|---|---|---|---|
| 215-692 | Thesis | 9 | Credits |
| | **Total** | 36 | Credits |

## 8. Course Descriptions

### 8.1. Seminar

215-601 Seminar in Mechanical Engineering 1* (0-2-1)

Literature survey in libraries and other sources to follow the progress in topics of interest in mechanical engineering and related areas for presentation; participation in presentation and discussion in department seminar

* No credit will be granted. Evaluation will be only S/U.

### 8.2. Compulsory Courses

215-613 Mathematical Methods in Engineering 3(3-0-6)

Methods of solution of first and second order ordinary differential equations; Laplace transforms, series solutions; methods of solution of first and second order partial differential equations; separation of variables and Fourier series; Fourier transforms; matrices; vector differential calculus; complex analysis; applications of mathematics to problems in engineering

215-614 Research Methodology 3(3-0-6)

Definition, research objectives, scope of research, defining problems, literature review, research methodology; statistical method for research, analysis and interpretation of data; research presentation, research proposal and report writing, ethics in research

### 8.3. Approved Elective Courses

215-612 Finite Element Method 3(3-0-6)

Theoretical and conceptual basis for the finite element method; finite element formulation using various techniques; direct approach, method of weighted residual and variational approaches; application to stress deformation problems; heat and fluid flow problems; introduction to finite element softwares

215-653 Computational Fluid Dynamics 3(3-0-6)

Fundamentals of finite-difference methods, finite element methods, and the method of characteristics; applications for numerical solutions of fluid dynamics

215-648 System Optimization 3(3-0-6)

Modeling of mechanical system; constructing system model; principle of optimization; Lagrange multipliers; search methods; dynamic programming; geometric programming; linear programming

**8.4. Free Elective Courses**

215-611 Theory of Engineering Experimentation 3(3-0-6)

Principle of experimental design; error and uncertainty in experimentation; planning experiments from error analysis; reduction of variables and dimensional analysis; test sequence and experimental plans, randomized block, Latin square and factorial plans; statistical data analysis, Chi-square test and Student's-t test; graphical and mathematical data analysis

215-621 Linear System Analysis 3(3-0-6)

Linear space and linear operators; mathematical representations of linear systems; state space and input-output models of linear systems; analysis in time and frequency domains; controllability, observability and stability

215-622 Control Systems 3(3-0-6)

Strategies for control; control system modeling; mathematics, block diagram, power bond graph, etc; using error, stability, root locus, frequency response, and digital simulation techniques in system design; stability, natural modes, controllability, and observability of multi-variable systems; multi-variable feedback; introduction to digital, adaptive, and optimal control

215-623 Fluid Power Automation 3(3-0-6)

Automation technology; power drives for industrial robots and automation machines; pneumatic systems for powered control and for logic; hydraulic control systems; electrohydraulic systems; design and prediction of dynamic performance of powered drive control systems by modeling and simulation

215-624 Sound and Acoustics 3(3-0-6)

Vibrations, waves, and sound; sound measurement, hearing, sound pressure, power and loudness; musical instruments; human voice; sound in enclosures; loudspeakers; microphones; environmental noise and control

215-625 System Modeling and Simulation 3(2-2-5)

Advanced modeling of physical dynamic systems, numerical techniques for simulating system response; experimental model identification and verification, parameter sensitivity and parameter optimization techniques

215-626 Vibrations of Discretized Systems 3(3-0-6)

Theory of small oscillations of discrete or discretized systems of high dimensionality; formulation of equations of motion using Lagrange's equation and influence coefficients; finite element reductions of continuous systems; natural frequencies and modes; numerical methods; free vibrations and forced vibration characteristics; model expansion; approximation techniques; damping; assembly of large systems from subsystems concepts, impedance techniques

215-627 Vibrations of Continuous Systems 3(3-0-6)

Theory of small oscillations of continuous systems; Love's equations for thin shells, reduction to special cases of shallow shells, plates, beams, etc; initial stresses; influence of shear; thermal excitation; initial value problems; forced vibrations; structural damping; the dynamic Green's function, impedance concepts; variational approaches; experimental procedures, scaling, composite, and stiffened shells

215-628 Matrix Methods in Analysis of Mechanisms 3(3-0-6)

Review of linear algebra; definition and terminology; coordinate system; homogeneous coordinates; transformation between coordinate systems; topological analysis of mechanisms; loop and path identifications; position analysis; loop closure equations; velocity and acceleration analyses; search for static equilibrium positions; dynamic equations for motion; time integration technique

215-629 Introduction to CAD/CAM 3(3-0-6)

Hardware and software; geometric modeling; curves, surfaces, solids, computer graphic and animation; rapid prototype; CNC machine; tool path generation and verification

215-631 Theory of Elasticity 3(3-0-6)

Plane stress and plane strain; two-dimensional problems in rectangular and polar coordinates; three-dimensional problems; theory of plates and shells; stress wave propagation in elastic solid media

215-632 Theory of Plasticity 3(3-0-6)

Analysis of stress, strain, strain rate; yield surface; plastic stress-strain relations; applications of plasticity theory to metal forming and removal

215-633 Fracture Mechanics 3(3-0-6)

Mechanics of failure; three-dimension theories of failure; plane stress and plane strain; energy approach analysis of fracture mechanics; stress intensity approach; stress field in the vicinity of crack tip, crack tip plastic zone; fatigue fracture; design components against fracture

215-634 Experimental Stress Analysis 3(3-0-6)

The continuum concepts of stress, stress boundary conditions, principal stresses and strains; The elastic constitutive relations; three dimension stress and strain; plane stress and plane strain; strain gauge technique; stress analysis using strain gauges, brittle lacquer technique and photo-elasticity techniques

215-641 Advanced Thermodynamics 3(3-0-6)

The empirical, physical basis of the laws of thermodynamics; availability concepts and applications; properties and relations between properties in homogeneous and heterogeneous systems;

the criteria of equilibrium; application to a variety of systems and problems including phase and reaction equilibrium

215-642 Heat Conduction and Thermal Radiation 3(3-0-6)

Fundamentals of heat conduction; analytical and numerical methods for the problems of steady and transient heat conduction; thermal radiation properties of gases, liquids, and solids; calculation of radiant energy transfer

215-643 Heat Convection 3(3-0-6)

Introduction to fluid flow and boundary-layer theory; the transport of heat in fluid flow; free and forced convection in laminar and turbulent flow; internal and external flow; condensation and boiling heat transfer; heat exchanger design

215-644 Thermal System Design 3(3-0-6)

The engineering design process; essential economic data for designing engineering systems; applications of fluid flow, heat transfer, and thermodynamics in analysis and modeling of engineering systems; introduction to numerical analysis

215-645 Advanced Refrigeration and Air Conditioning 3(3-0-6)

Processes, cycles and design problems for low temperature systems, liquefaction and production of industrial gases and absorption systems; advanced studies and design of residential, commercial and industrial air conditioning systems and economic considerations; theories and methods of food freezing and preservation; new refrigerants

215-646 Advanced Power Plant Engineering 3(3-0-6)

Steam turbine and gas turbine power plants; complex combined cycle power plants; utilization of coal in gas turbine through gasification process; combined cycle power plant with coal as fuel; potential of private power generation; modern diesel power plant; nuclear power plant; fast breeder nuclear power plant; fusion reactor; electricity generation through magneto-hydrodynamic process

215-647 Gas Turbine and Application 3(3-0-6)

Principles of thermodynamics and fluid dynamics utilized in analyses and designs of gas-turbine cycles, components and systems for power plant, automotive and aircraft applications

215-651 Advanced Fluid Mechanics 3(3-0-6)

Dynamics of fluid flow; force on a submerged cylinder and Joukowski transformation; airfoil characteristics and applications to turbine blade design; three-dimensional wing theory; induced drag and airfoil sections; gas dynamics; one-dimensional and isentropic flow of perfect gas; isentropic flow through ducts of variable cross-sectional areas, choking effects and normal shock wave; flow in constant-area ducts with friction and heat transfer; oblique shock wave; Prandtl-Meyer flow and methods of analysis

215-652 Gas Dynamics 3(3-0-6)

Flow of compressible fluids; one-dimensional flows, basic concepts, isentropic flow, normal and oblique shock waves, Rayleigh line, Fanno line, and simple waves; multidimensional flows including general concepts, small perturbation theory for linearized flows and method of characteristics for

nonlinear flows

215-654 Multiphase Flow 3(3-0-6)

Nature of multiphase flow; Gas-liquid, gas-solid, liquid-solid two phase and two-component flows; three-phase flows; vertical and horizontal flows; flow patterns; correlations; pressure drop in two-phase flows; isothermal flows; flows with heat transfer; applications in material handling

215-655 Viscous Flow 3(3-0-6)

Exact solutions of Navier-Stokes equations; low-Reynolds number flow; laminar boundary layer; unsteady viscous flow

215-656 Turbulent Flow 3(3-0-6)

Physical phenomena of turbulence; spatial and temporal velocity correlations; momentum and heat transport; kinetic energy of turbulence; vorticity dynamics; shear flows; statistical description of turbulence; measurement techniques; hot-wire anemometer; current topics in turbulence

215-657 Aerosol Science and Engineering 3(3-0-6)

Fundamentals of aerosol science; elementary particle mechanics; Brownian motion and diffusion; evaporation and condensation; coagulation; filtration

215-661 Energy Resources and Energy Conversion I 3(3-0-6)

Current situation, technology, and outlook of energy sources and consumptions specifically focused on renewable energy resources: wind, tidal, wave, hydroelectricity, bio-energy, and miscellaneous

215-662 Thermal Energy Analysis 3(3-0-6)

Second law of thermodynamics and availability analysis; second law efficiencies; availability property relations, property diagram; energy audit and management in various thermal energy systems, e.g., boiler, furnaces, steam equipment, air conditioning system, co-generation system; Lindhoff analysis; thermoeconomic analysis

215-663 Energy Management in Buildings 3(3-0-6)

Comfort cooling and psychrometry; air quality and air change Building utility, facility and energy requirement; building energy load and thermal dynamics; solar heat gain, shading; measurement and control of energy; instrumentation for measurement and control

215-664 Energy Management and Policy 3(3-0-6)

Energy fundamentals: role of energy, present energy demands, future trends, and major problems associated with the use of energy; major energy policies and management programs taken by government particularly in Thailand and generally throughout the global; energy conservation methods, techniques to reduce energy consumption, and waste heat management

215-665 Energy from Biomass and Conversion 3(3-0-6)

Potential of biomass as an energy source; biomass resource, biomass production, forms of biomass and problems in recovering of biomass; thermal conversion; direct combustion, gasification, pyrolysis, large scale power production from biomass and methanol production; biological conversion;

anaerobic digestion, ethanol production and industrial biogas production and pollution control; plant-derived oil as an energy source; operation of gas turbine on biomass fuels

215-666 Combustion 3(3-0-6)

Physical and chemical aspects of basic combustion phenomena; classification of flames; measurement of laminar flame speed; factors influencing burning velocity; theory of flame propagation; flammability; chemical aspects; chemical equilibrium; chain reactions; calculation and measurement of flame temperature; diffusion flames; fuels; atomization and evaporation of liquid fuels; theories of ignition, stability and combustion efficiency

215-667 Theory of Drying 3(3-0-6)

Theory of drying; moisture in gases and solids, moisture isotherm, correlation of moisture-equilibrium data, characteristic drying curve, critical-point curve; drying of agricultural products by heated air; heat and mass balances in batch and continuous drying process; performance of dryers

215-668 Energy Resources and Energy Conversion II 3(3-0-6)

Current situation, technology, and outlook of energy sources and consumptions; specifically focused on renewable energy resources: solar thermal energy, solar photovoltaic, geothermal energy, hydrogen energy and fuel cell, and miscellaneous

215-671 Expert Systems 3(3-0-6)

Expert system tools; knowledge representation in expert systems; reasoning under uncertainty; designing and building an expert system; expertise transfer for expert system design; testing and evaluating of expert systems

215-672 Principles of Robotics 3(3-0-6)

History and applications of robots; robot configurations; spatial descriptions and transformations of objects in three-dimensional space; forward and inverse manipulator kinematics; task and trajectory planning; simulation and off-line programming

215-673 Design of Electromechanical Systems 3(3-0-6)

Analog electronic design for purpose of controlling electromechanical systems; treatment of electromechanical sensors and actuators, as well as analog electronic design of filters, state space and classical controllers, and transistor-based servo amplifiers and high voltage amplifiers

215-674 Robot Control 3(3-0-6)

Dynamics and control of robot manipulators; Jacobian matrix relating velocities and static forces; linear and angular acceleration relationships; manipulator dynamics; manipulator mechanism design; linear and nonlinear control; force control of manipulators

215-675 Programming of System Modeling and Simulation 3(2-2-5)

Programming for state-determination of multi-domain system state; using software for modeling of electrical, mechanical, mechatronic, and thermal energy domains, and emphasis on multi-domain interaction

215-681 Advanced Topics in Mechanical Engineering I 3(3-0-6)

Advanced current topics of interest in mechanical engineering

215-682 Advanced Topics in Mechanical Engineering II 3(3-0-6)

Advanced current topics of interest in mechanical engineering

215-683 Advanced Topics in Mechanical Engineering III 3(2-2-5)

Advanced current topics of interest in mechanical engineering

215-684 Advanced Topics in Mechanical Engineering IV 3(2-2-5)

Advanced current topics of interest in mechanical engineering

**8.5. Master's Thesis**

215-691 Thesis 48(0-144-0)

Research on topics of interest in mechanical engineering under the supervision of advisors; presentation and oral examination every registered semester; preparation of thesis in proper form

215-692 Thesis 36(0-108-0)

Research on topics of interest in mechanical engineering under the supervision of advisors; presentation and oral examination every registered semester; preparation of thesis in proper form