

# AUTO-TU

Automotive Engineering Program, TEP-TEPE  
Faculty of Engineering, Thammasat University

## 2013 Curriculum

### Structure

Subject groups	Credits
1) General Education Courses	30
2) Engineering Courses	110
2.1) <i>Core Courses</i>	24
2.2) <i>Compulsory Courses</i>	74
2.3) <i>Technical Electives</i>	12
3) Free Electives	6
Total	146

**Study Plan**

Year 1		
Semester 1		Credits
ME100	Engineering Graphics	3
CE100	Engineering Ethics	0
MA111	Fundamental Calculus	3
SC123	Fundamental Chemistry	3
SC133	Physics for Engineers I	3
SC173	Fundamental Chemistry Laboratory	1
SC183	Physics for Engineers Laboratory I	1
TH161	Thai Usage	3
ELxxx	English Course	3
Total		20

Semester 2		Credits
CE101	Introduction to Engineering Profession	1
IE121	Engineering Material	3
MA112	Analytic Geometry and Applied Calculus	3
SC134	Physics for Engineers II	3
SC184	Physics for Engineers Laboratory II	1
TU100	Civic Education	3
TU130	Integrated Science and Technology	2
ELxxx	English Course	3
Total		19

Year 2		
Semester 1		Credits
ME200	Mechanical Drawing	2
ME230	Fundamental of Thermodynamics	3
LE209	Introduction to Electrical Engineering	3
LE203	Introduction to Electrical Engineering Laboratory	1
ME291	Engineering Mechanics	3
IE261	Engineering Statistics	3
MA214	Differential Equation	3
TU156	Introduction to Computers and Programming	3
Total		21

Semester 2		Credits
AU200	Automotive Engineering I	2
ME210	Mechanics of Materials	3
ME231	Thermodynamics for Mechanical Engineers	3
ME240	Mechanics of Fluids	3
IE251	Manufacturing Processes for Mechanical Engineers	3
IE252	Engineering Tools and Operations Laboratory	1
MA131	Applied Linear Algebra	3
TU110	Integrated Humanity	2
Total		20

Year 3		
Semester 1		Credits
AU300	Automotive Engineering II	2
ME312	Machine Design	3
AU320	Vehicle Dynamics	3
AU330	Internal Combustion Engines	3
ME350	Numerical Methods for Engineers	3
TU120	Integrated Social Sciences	2
Total*		16

\*For Co-op option, take 3 more credits of Free Elective course. Total 19 credits

Semester 2		Credits
ME390	Mechanical Engineering Laboratory	1
AU350	Computer Aided Automotive Engineering	3
AU351	Sensor Technology in Automotive Engineering	2
ME322	Mechanical Vibration	3
ME331	Heat Transfer	3
AU361	Management of Automotive Manufacturing Process	3
AUxxx	Elective Course	3
Total**		18

\*\* For Co-op option, takes 2 credits of General Education course. Total 20 credits

Summer		Credits
AU380	Industrial Training	0

Year 4 (Project option)		
Semester 1		Credits
AU410	Automotive Design	3
AU450	Automotive Control	3
AU480	Automotive Engineering Seminar	0
ME430	Refrigeration and Air-conditioning	3
ME431	Power Plant Engineering	3
Auxxx	Technical Elective	3
EL202	English for Work	3
Total		18
Semester 2		Credits
AU481	Automotive Engineering Project	3
AUxxx	Technical Elective	3
xx.xxx	Free Elective	3
xx.xxx	Free Elective	3
xx.xxx	General Education	2
Total		14
Overall credits		146

Year 4 (Co-op option)		
Semester 1		Credits
AU410	Automotive Design	3
AU450	Automotive Control	3
AU480	Automotive Engineering Seminar	0
AU482	Preparation for Automotive Engineering Co-operative Education	3
ME430	Refrigeration and Air-conditioning	3
ME431	Power Plant Engineering	3
EL202	English for Work	3
xx.xxx	Free Elective	3
Total		21
Semester 2		Credits
AU483	Automotive Engineering Co-operative Education	6
Total		6
Overall credits		146

**List of Technical Elective Courses**

AU 414	Design of Commercial Vehicles	3	(3-0-6)
AU 415	Design of Automotive Structures	3	(3-0-6)
AU 416	Automotive Chassis Systems	3	(3-0-6)
AU 417	Automotive Power Transmission Systems	3	(3-0-6)
AU 418	Automotive Material Technology	3	(3-0-6)
AU 419	Motorcycle Technology	3	(3-0-6)
AU 424	Construction and Agricultural Vehicles	3	(3-0-6)
AU 435	Automotive Power Plant Technology	3	(3-0-6)
AU 444	Vehicle Aerodynamics	3	(3-0-6)
AU 465	Industrial Robots	3	(3-0-6)
AU 466	Regulations and Standards in Automotives	3	(3-0-6)
AU 474	Ride Safety and Comfort Technology	3	(3-0-6)
AU 494	Special Topics in Automotive Engineering I	3	(3-0-6)
AU 495	Special Topics in Automotive Engineering II	3	(3-0-6)
AU 496	Special Topics in Automotive Engineering III	3	(3-0-6)
AU 497	Special Topics in Automotive Engineering IV	3	(3-0-6)
ME 325	Pneumatics and Hydraulics	3	(3-0-6)
ME 364	Integrated Product Design and Development	3	(3-0-6)
ME 414	Failure of Engineering Materials	3	(3-0-6)
ME 454	Introduction to Finite Element Method	3	(3-0-6)
ME 464	Plant Engineering	3	(3-0-6)
ME 474	Agricultural Machinery	3	(3-0-6)
ME 475	Introduction to Biomechanics	3	(3-0-6)

## Course Description

### **AU 200 Automotive Engineering I** **2 (1-3-4)**

Prerequisite : -

History of automobile. Classification of automobiles. Road conditions. Introduction to automotive sub-systems and their components. Terminology and unit of measurement in automotive. Introduction to vehicle power plants. Automotive bodies and structures, transmission systems, wheels and tires, suspensions, steering and brakes systems. Rules and regulations. Automotive design process. Automotive manufacturing processes. Laboratory sessions explore components and sub-systems in automobiles.

### **AU 300 Automotive Engineering II** **2 (1-3-4)**

Prerequisite : -

Liquid and gaseous fuels. Combustion. Engines and control systems. Lubrication and cooling system. Alternative power sources. Automotive Electrical system. Equipment for safety and comfort. Auxiliary systems. Maintenance. Future trend of automobiles. Laboratory sessions cover engine disassembly and assembly and dynamometer test.

### **AU 300 Automotive Engineering II** **2 (1-3-4)**

Prerequisite : -

Liquid and gaseous fuels. Combustion. Engines and control systems. Lubrication and cooling system. Alternative power sources. Automotive Electrical system. Equipment for safety and comfort. Auxiliary systems. Maintenance. Future trend of automobiles. Laboratory sessions cover engine disassembly and assembly and dynamometer test.

### **AU 320 Dynamics of Vehicles** **3 (3-0-6)**

Prerequisite : Have earned credits of ME 291

Theory of vehicle dynamics and the applications on various types of automotives such as passenger cars, trucks and motorcycles. Traction. Analysis of suspension system: types, suspension geometry, roll center, springs, anti-roll bars and shock absorbers. Analysis of steering system: steering mechanism, steering geometry. Analysis of brake system. Road conditions. Study of handling and braking characteristics as affected by various parameters such as track width, wheel base, center of gravity, drive configuration, spring stiffness, steering geometry, wheel size, orientation of king pin axis, etc. Dynamics of crash.



**AU 330 Internal Combustion Engines 3 (3-0-6)**

Prerequisite : Have earned credits of ME 231

Internal combustion engine fundamentals. Engine components. Thermodynamics of spark ignition and compression ignition engines. Combustion processes. Power output. Smoke limit. Exhaust gas analysis and pollution control. Equilibrium charts. Fuels, carburetion and injection systems. Scavenging process. Lubrication. Fuel-air cycles. Engine performance improvement techniques such as supercharging, etc. Engine performance testing and analysis. Engine design. Introduction to current engine technology.

**AU 350 Computer Aided Automotive Engineering 3 (3-0-6)**

Prerequisite : -

Computer aided drawing: solid modeling, free-form geometry, assembly. Fundamental of finite element method. Computer aided engineering analysis: kinematic analysis, heat transfer analysis. stress-strain analysis, computational fluid dynamics, non-linear analysis. Laboratory sessions cover utilization of commercial software in automotive design analysis.

**AU 351 Sensor Technology in Automotive Engineering 2 (1-3-4)**

Prerequisite : -

Sensor technology for measurement and detection of engineering quantities such as: position distance, velocity, acceleration, force, strain, pressure, temperature, humidity, flow rate, combustion efficiency, knock sensor, light intensity, sound level, etc. Sensor output and data transmission. Data acquisition and processing. Introduction to applications of sensors in vehicles: engine and power train management, cruise control, brake system control, vehicle stability control, etc. Laboratory sessions study different kinds of measuring instruments.

**AU 361 Management of Automotive Manufacturing Process 3 (3-0-6)**

Prerequisite : -

Process planning. Process modeling and simulation. Management and control of processes. Quality control. Manufacturing engineering software tools. Virtual plant layout. Logistics and supply chain management in the global automotive industry.

**AU 380 Industrial Training 0 (0-240-0)**

Prerequisite : In the third year status and pass English test score according to the department criteria

Students must be trained at least six consecutive weeks (not less than 240 hours) in industries or similar sectors. Submissions of reports are required together with comments or

certifications from the trainers. Evaluation in satisfactory (S) or unsatisfactory (U)

**AU 410 Automotive Design 3 (2-3-4)**

Prerequisite : Have earned credits of AU 200

Ergonomics. Automotive design focuses on system and sub-system design. Design procedures. Overall vehicle layout. Structural design. Aerodynamics issues. Selection of power plant. Design of transmissions and drivelines. Design of suspension, steering and brake systems. Laboratory sessions cover design practice. Group design project.

**AU 414 Design of Commercial Vehicles 3 (3-0-6)**

Prerequisite : Have earned credits of AU 200

The course covers design of commercial vehicles such as pick-up truck, heavy trucks, trailers and buses. Focus on system and sub-system design. Standards, rules and regulations. Design procedures. Overall vehicle layout. Structural design. Selection of power plant. Design of transmissions and drivelines. Design of suspension, steering and brake systems. Group design project.

**AU 415 Design of Automotive Structures 3 (3-0-6)**

Prerequisite : Have earned credits of ME 210

Review of solid mechanics and engineering materials. Theory of failure. Type of automobile and motorcycle structures. Dynamic loads. Beam models. Torsional rigidity of structures. Impact attenuation. Computer aided analysis of structures. Crash analysis. Structure design examples.

**AU 416 Automotive Chassis Systems 3 (3-0-6)**

Prerequisite : Have earned credits of AU 200 and AU 320

Review of vehicle dynamics. Study and design of components in suspension, steering and brake systems. Suspension system: linkages, bushes, springs, torsion bars and shock absorbers. Steering system: steering wheel, steering post, universal joints, racks and pinions, power assist component, tie rods, uprights and related mechanisms. Brake system: brake pedal, master cylinders and related hydraulic system, brake assist and related vacuum system, disc brake component, drum brake components.

**AU 417 Automotive Power Transmission Systems 3 (3-0-6)**

Prerequisite : Have earned credits of ME 310

Study and design of automotive power transmission systems. Components in power

transmission system. Drive configuration. Design of gear ratios. Continuously variable transmission. Gear shifting strategy. Torque distribution in four-wheel drive system. Analysis, design and selection of driveline components: flywheels, clutch systems, torque converters, gear trains, chain, gear shifting mechanism, differential, drive shafts, CV joints, wheel hubs, etc.

**AU 418 Automotive Material Technology 3 (3-0-6)**

Prerequisite : -

Introduction to automotive materials. Materials properties, selection and databases. Advanced metal material: high strength steels, aluminium alloys, magnesium and titanium alloys. Engineering polymers. Tire materials. Composite materials. Engineering ceramics and glasses. Fabrics and leathers. Insulations. Corrosion prevention and painting. Manufacturing technology for different types of materials. Recycling.

**AU 419 Motorcycle Technology 3 (3-0-6)**

Prerequisite : -

Motorcycle's parts. Type of motorcycles. Review of vehicle dynamics of motorcycles. Structure, power plant, power transmission, brake and suspension systems. Wheels and tires. Sensor and control systems. Safety technology. Related rules and regulations. Maintenance. Motorcycle manufacturing process. Future trend of motorcycles.

**AU 424 Construction and Agricultural Vehicles 3 (3-0-6)**

Prerequisite : -

Introduction to construction and agricultural vehicles. Structures, main and auxiliary power plants. Caterpillar tractor system. Hydraulic and pneumatic systems. Wire rope system. Maintenance. Case studies of construction and agricultural vehicles. Related rules and regulations. Future trend.

**AU 435 Automotive Power Plant Technology 3 (3-0-6)**

Prerequisite : Have earned credits of ME 330

Review of internal combustion engines, spark ignition and compression ignition. Emission control. Engine management. ECU mapping. Engine performance test. Performance and fuel economy improvement techniques. Effect of using various types of liquid and gaseous fuel. Introduction to engine technologies such as variable valve action, fuel injection system, intake and exhaust manifold technologies, turbo chargers and supercharger technologies, lubrication

technology, etc. Introduction to electrical power plant technology: motor, fuel cell, battery technologies. Hybrid technology. Future trend of automotive power plants.

**AU 444 Vehicle Aerodynamics 3 (3-0-6)**

Prerequisite : Have earned credits of ME 240

Principle of aerodynamics. Drag and lift. Ground effect. Minimum drag body. Optimum shape design. Aerodynamics effects on automobile and motorcycle performance. Design of body attachments for aerodynamics improvement. Braking with air drag. Dimensional analysis and scale modeling. Wind tunnel test. Computational fluid dynamics.

**AU 450 Automotive Control 3 (3-0-6)**

Prerequisite : Have earned credits of ME 291 and MA 214

System model. System responses. Basic of controls. Logic control. Feed back control. Control system designs. Automotive control system design: system model, actuator, sensor and electronic control. Automotive control system case studies: engine and power train management, cruise control, brake system control, traction control, vehicle stability control, etc.

**AU 465 Industrial Robots 3 (3-0-6)**

Prerequisite : -

Types of industrial robots. Review of matrix calculus. Motion analysis of robots. Inverse kinematics of robot mechanism. Load analysis. Strength analysis of structure and mechanism. Mechanical power sources. Selection of sensors. Basic robot control. Optimal trajectories. Robot vision and artificial intelligence. Applications of robots in automotive industry. Trips to robot-assembly plants.

**AU 466 Regulations and Standards in Automotives 3 (3-0-6)**

Prerequisite : -

Study of national and international standards and laws governing automotives. Standard issuing organizations. Safety standard. Crash test condition. Engine testing standard. Regulation on Emission. Future trend.

**AU 474 Ride Safety and Comfort Technology 3 (3-0-6)**

Prerequisite : -

Safety standards, rules and regulation. Active and passive safety technologies: anti-lock brake system, brake assist, vehicle stability control, safety belt, airbag, impact absorption.

Pedestrian safety. Crash test methods. Ergonomics. Visibility: lighting and signaling, night vision, wipers and water repellent technology. Thermal comfort conditions. Vehicle noise vibration and harshness control technologies.

**AU 480 Automotive Engineering Seminar 0 (0-3-0)**

Prerequisite : -

Research. Report writing. Presentation of interesting topics in automotive engineering by students and guest speakers. Evaluation in satisfactory (S) or unsatisfactory (U).

**AU 481 Automotive Engineering Project 3 (0-6-3)**

Prerequisite : : The fourth-year students must pass the English Brush-Up training course or hold a TU-GET score of at least 300 points, and have earned credits of AU480 or Permission from Instructor and Department Head

Project related to mechanical engineering for students to self-practice in conducting experiment, research, development or study in specific topics under advisement of faculty members. Written report and oral presentations are required upon completion of the project.

**AU 482 Preparation for Automotive Engineering Co-operative Education 3 (0-6-3)**

Prerequisite : Have earned credits of ME 380

Study and problem solving in industry for the purpose of research and development. The study is conducted individually or in groups not exceeding 3 students and fits the following description (1) a search for invention that can be developed into commercialized product, (2) problem solving in manufacturing, process improvement, or utilization of deflections or rejects, (3) technological improvement (from those granted patent), management of information and servicing for business decision making. The duration of course is not to be less than 4 months and not exceeding 6 months. It is evaluated by committee consisting of lecturers and industrial associates. Students are required to submit reports and make oral presentation.

**AU 483 Automotive Engineering Co-operative Education 6 (16 weeks in one semester)**

Prerequisite: Have earned credits of ME 482

Study and problem solving in industry in continuation from AU 482. This course cover the process of analysis and development of work according to the research methodology studied in AU 482. (16 weeks of practice)

**AU 494 Special Topics in Automotive Engineering I 3 (3-0-6)**

Prerequisite : -

Study of interesting topics in Automotive Engineering.

**AU 495 Special Topics in Automotive Engineering II 3 (3-0-6)**

Prerequisite : -

Study of interesting topics in Automotive Engineering.

**AU 496 Special Topics in Automotive Engineering III 3 (3-0-6)**

Prerequisite : -

Study of interesting topics in Automotive Engineering.

**AU 497 Special Topics in Automotive Engineering IV 3 (3-0-6)**

Prerequisite : -

Study of interesting topics in Automotive Engineering.

**Course Description (Mechanical Engineering Courses)****ME 100 Engineering Graphics 3 (2-3-4)**

Prerequisite : -

The significance of drawing. Instruments and their uses. Lining and lettering. Work preparation. Applied geometry. Dimensioning and description. Orthographic drawing. Pictorial drawing. Freehand sketching. Sectioning. Computer aided drawing.

**ME 200 Mechanical Drawing 2 (1-3-2)**

Prerequisite : Have earned credits of ME 100

Basic descriptive geometry. Intersection and development of surfaces. Symbols in mechanical drawing. Piping drawing. Welding drawing. Drawing of machine elements. Specification of surface finish. Allowance and tolerance. Assembly and detailed drawing. Computer aided drawing.

**ME 210 Mechanics of Materials 3 (3-0-6)**

Prerequisite : -

Forces and stresses. Review of engineering materials. Stresses and strains relationship. Stresses in beams Shear force and bending moment diagrams. Deflection of beams. Torsion.

Buckling of columns. Stresses in pressure vessels. Mohr's circle and combined stresses. Statically indeterminate systems. Hooke's law. Strain energy. Failure criterion. Introduction to finite elements. Stress measurement.

**ME 230 Fundamental of Thermodynamics 3 (3-0-6)**

Prerequisite : Have earned credits of SC 133

Properties of pure substances. Equation of state for ideal and real gas. Thermodynamics diagrams and tables. First law of thermodynamics. Second law of thermodynamics. Carnot cycle. Energy. Entropy. Heat transfer. Energy conversion.

**ME 231 Thermodynamics for Mechanical Engineers 3 (3-0-6)**

Prerequisite : Have earned credits of ME 230

Irreversibility and availability. Power cycles and refrigeration cycles. Thermodynamics relation. Mixtures and solutions. Combustion processes and analysis of combustion products.

**ME 240 Mechanics of Fluids 3 (3-0-6)**

Prerequisite : Have earned credits of SC 133

Properties of fluids. Fluid statics. Buoyancy. Momentum equation. Energy equation. Angular momentum equation and its application to turbo machinery. Kinematics of incompressible and non-viscous fluid flow. Finite control volume and differential analysis. Dimensional analysis and similitude. Incompressible and viscous fluid flow. Flow in pipes. Fluid measurement. Introduction to boundary layer theory. Introduction to turbulent flow.

**ME 291 Engineering Mechanics 3 (3-0-6)**

Prerequisite : Have earned credits of SC 133

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

**ME 312 Machine Design 3 (3-0-6)**

Prerequisite : Have earned credits of ME 210

Design procedure. Factor affecting design. Safety factor. Review of solid mechanics, engineering materials, theories of failure. Stress concentration. Design of mechanical element for load bearings such as beams, shafts, threaded fasteners and joints. Mechanical power sources. Design of machine elements such as springs, power screws, rotating shaft, keys, flywheels, couplings, brakes, bearings, belts, chains and gears. Design of machines. Design for manufacturing and assembly. Reverse engineering case studies. Introduction to computer

aided design and engineering.

**ME 322 Mechanical Vibrations 3 (3-0-6)**

Prerequisite : Have earned credits of ME 291 and MA 214

The behavior of lumped systems with single degrees of freedom. Natural frequency and damping effects. Principles of vibration isolation and vibration measuring instruments. Lumped systems with two degrees of freedom: natural frequencies, modes, and mode shapes. Principle of dynamics vibration absorbers. Lumped systems with several degrees of freedom. Whirling of shafts. Introduction to distributed parameter systems. Introduction to non-linear systems. Introduction to numerical solution of vibration problems

**ME 325 Pneumatics and Hydraulics 3 (3-0-6)**

Prerequisite : Have earned credits of ME 240 or Permission from Instructor and Department Head

Fundamental of fluid power systems and their applications. Pneumatic and hydraulic circuit. Structure and principle of pneumatic and hydraulic systems. Design and drawing of the circuits. Basic circuit. Cascade circuit. Flow control with electric. Ladder diagram. PLC. Selection of equipments such as air-compressor, pressure tank, control valves, actuator etc. Efficiency. Installation, maintenance and trouble shooting. Application to industry.

**ME 331 Heat Transfer 3 (3-0-6)**

Prerequisite : Have earned credits of ME 230 and ME 240

Conduction: steady state. One and two-dimensional heat conduction. One dimensional unsteady state conduction. Convection: dimensional analysis in convection heat transfer. Natural convection on plane and cylindrical surfaces. Forced convection on circular pipe. Plane surface and in conduits. Simplified analysis in convection heat transfer. Relationship between heat transfer and fluid friction. Condensation and boiling. Radiation: absorption and emission characteristics. Angle factor. Radiation of black and gray bodies. Heat exchangers. Introduction to numerical methods for solution of heat transfer problems.

**ME 350 Numerical Method for Engineers 3 (3-0-6)**

Prerequisite : Have earned credits of TU 156 MA 131 and MA 214

Fundamental of numerical method. Numerical approximation and error analysis. Numerical solutions of system of linear and non linear equations. Numerical integration. Finite difference approximation of derivatives. Discretization of differential equations. Development of



algorithm and computer programs for practical applications.

**ME 364 Integrated Product Design and Development 3 (3-0-6)**

Prerequisite :Have earned credits of IE 251 or Permission from Instructor and Department Head

Product design under engineering principles. Design for manufacturing. Business opportunity for new product. Design method. Modeling. Decision making. Risk. Pricing. Selections of materials and manufacturing process. Team working. Creativity and innovation.

**ME 390 Mechanical Engineering Laboratory 1 (0-3-0)**

Prerequisite : -

Significant digits. Error analysis of experimental data. Data analysis and presentation. Engineering report writing. Experiments involve fluid mechanics, thermodynamics, dynamics and solid mechanics.

**ME 414 Failure of Engineering Materials 3 (3-0-6)**

Prerequisite : Have earned credits of ME 210 and IE 121 or Permission from Instructor and Department Head

Introduction of material failures. Fracture and deformation of materials. Behaviors and mechanisms of failure under static and repeated loads. Fatigue crack initiation and fatigue crack growth. Wear. Corrosion. Material testings.

**ME 430 Refrigeration and Air Conditioning 3 (3-0-6)**

Prerequisite : Have earned credits of ME 331

Reviews of thermodynamics principles. Principles of refrigeration and various refrigeration systems. Single stage and two stages mechanical vapor compression refrigeration cycles. Main components such as compressor, condenser, evaporator, refrigerant flow control equipment. Auxiliary equipment. Refrigerants. Psychrometrics. Air conditioning system design. Introduction to current refrigeration and air conditioning technology. Cooling load calculation for refrigeration and air conditioning systems. Duct design. Principles of air distribution and diffuser selection.

**ME 431 Power Plant Engineering 3 (3-0-6)**

Prerequisite : Have earned credits of ME231

Types and characteristics of power plants. Load calculation. Hydro power plant. Diesel power plant. Steam power plant. Steam turbine. Boiler. Condenser. Feed water heater and auxiliary

equipment. Gas turbine power plant. Combined cycle power plant. Nuclear power plant. Introduction to current power plant technology.

**ME 454 Introduction to Finite Element Method 3 (3-0-6)**

Prerequisite : Have earned credits of ME 350 or Permission from Instructor and Department Head

Mathematical preliminaries and matrices, general procedure of the finite element method, derivation of finite element equations using; direct approach, variational approach, and method of weighted residuals, finite element types in one, two, and three dimensions, and their interpolation functions, applications to structural, heat transfer, and fluid flow problems.

**ME 464 Plant Engineering 3 (3-0-6)**

Prerequisite : Have earned credits of ME 230, ME 231 and ME 310 or Permission from Instructor and Department Head

Plant location and layout. Design, installation, control and maintenance of various systems such as electrical system, hot water system, chilled water system, steam system, compressed air, gas system and fire protection system. Principle of typical equipment in industry such as motors, pumps, compressors, fans, conveyor systems, valves, mechanical seals etc. Preventive maintenance. Value engineering. Non-destructive testing. Trips to factories.

**ME 474 Agricultural Machinery 3 (3-0-6)**

Prerequisite : Have earned credits of ME 210 และ ME 240 or Permission from Instructor and Department Head

Basic knowledge of agricultural machinery: types, structure, operation and maintenance. Selection and performance testing. Mechanical properties of agricultural material such as soil, agricultural products etc. Design, strength and motion analysis of agricultural machinery. Detail study of some basic machinery.

**ME 475 Introduction to Biomechanics 3 (3-0-6)**

Prerequisite : Have earned credits of ME 210 and ME 291 or Permission from Instructor and Department Head

Related medical terms. Mechanical properties of biomaterials such as tissue, muscles, bones and fluids in mammals and structures of insect and trees etc. Static equilibrium and motion of the livings. Design of artificial organ. Measurement of mechanical properties in organs.

Introduction to in vivo study. Explanation of reasons behind nature's design with theories in mechanical engineering. Neural synapse. Vision and object recognitions.