8.1 ABOUT THE DEPARTMENT

Mechanical Engineering in the University of the Philippines began in January 10, 1916 when the UP Board of Regents approved the curricula leading to the degrees of Bachelor of Science and Master of Science in Mechanical Engineering. In the following academic year, 1916-1917, the degree program was officially opened, and the Department was first headed by Prof. Herman W. Reynolds from the University of California. The Department graduated its first batch of students in 1920, as the second oldest program in the College.

Mechanical Engineering had been viewed as a field which befits only the male students such that only one female student would enroll as an M.E. freshman in the 1970s to early 1980s. It was only starting 1998 when the number of female students has accounted for more than ten percent of the total M.E. freshmen population.

In the 1970s, the M.E. faculty offices occupied Room 217 of Melchor Hall until it was transferred in the early 80s to the former National Engineering Center Office in Room MH327. In 2002, the Department transferred to its current location at the ground floor of the M.E. Laboratories Building.

The M.E. Shop was located on the same block as the Met-Mining Pilot Plant, until it was transferred to the M.E. Laboratories Building in 1973. The Shop was housed in the German Yia Hall in the early 80s. The building was rebuilt in 2016 and the Shop was upgraded to the UPME Design and Manufacturing Center.

8.2 VISION

To be a world-class institution of Mechanical Engineering serving foremost the needs of our country, the Philippines

8.3 MISSION

- Consistently produce top quality Mechanical Engineering graduates.
- Continually develop new knowledge and undertake progressive research and development that will contribute to the industrial development of the nation.
- Provide technical expertise to industry and strengthen linkages and partnerships with other institutions.

8.4 UNDERGRADUATE PROGRAM

Mechanical engineering is the application of mechanics and thermodynamics. The major courses in the current program includes foundation courses in thermal sciences, metrology, kinematics and mechanisms, machine design, manufacturing, and control, as well as specialized courses in internal combustion engines, turbomachinery, power, and heating ventilation, air conditioning and refrigeration (HVACR).

In addition to the general education courses, the undergraduate mechanical engineering program also has a heavy requirement of mathematics, physics and engineering sciences courses. Students are also required to take courses in industrial, civil, electrical, electronics and metallurgical engineering. Elective courses are being offered for topics like vehicle engineering, naval architecture, computer aided design and manufacture, biomechanics.

The current program is laboratory-intensive. Students are expected to perform experiments, create projects, learn technical skills, and develop new designs. Students are encouraged to affiliate with the various research laboratories of the Department for further exposure, knowledge and training.

The Bachelor of Science in Mechanical Engineering (B.S. ME) curriculum is periodically revised to further strengthen and tune it to the new developments and requirements of the field.

8.5 GRADUATE PROGRAM

Master of Science in Mechanical Engineering

Objective

Provide advanced training in the methods, tools and techniques of mechanical engineering

Admission Requirements

Bachelor's degree in Mechanical Engineering and above average academic performance in the undergraduate level.

To qualify for the degree, a student must satisfy the following requirements:

1) complete a minimum of twenty-four (24) units of formal graduate courses;
2) maintain a cumulative weighted average grade (CWAG) of 2.00 or better in his/her graduate courses at the end of each academic year;
3) successfully defend a Master’s Thesis; and

4) submit at least five bound and certified copies of the approved Master's Thesis.

8.6 FACILITIES

With continuous effort to establish facilities and laboratories that will be useful for instruction, research, and mechanical engineering services, the Department of Mechanical Engineering maintains several laboratories and a manufacturing center.

Biomechanics Laboratory

The laboratory is involved in the research and development of computational tools for analyzing changes in forms and for studying human motion. It is equipped with a motion capture system and x-ray film scanner. Current research includes kinetics and statistical studies of human spinal configuration, biomorphometrics and gait analysis.

Computer Integrated Manufacturing Laboratory

This laboratory houses a 4-station CIM Cell set-up that is used to simulate production and manufacturing systems. It serves as an educational laboratory for students to understand different aspects of manufacturing such as quality control, optimization and automation. It is also functioning as research/design laboratory in flexible manufacturing system (FMS) with the use of two small scale CNC machines and different robotics arms.

Emerson Heating, Ventilation, Air Conditioning and Refrigeration Laboratory

With the support of Emerson Climate Technologies, this laboratory has been provided with trainers which practically demonstrate the actual components and operations of HVACR systems, including a number of application software, which are useful tool in digital modelling and optimization of HVACR components and systems. This approach is what companies are requiring in handling large-scale heating, refrigeration, and air conditioning projects. This laboratory serves both as an instructional laboratory for classes and as a research and development venue. Trainings, lectures, and seminars on HVACR are also catered here.

Machine Design Laboratory

The facility houses both hardware and software tools to complete the entire process of machine design, beginning form design concept, to computer aided design, to analysis, rapid prototyping and testing. This research laboratory houses unique equipment that allows for reverse engineering, design modifications and improvement, strength and dynamic analysis, design verification and design for manufacture.

Metrology Laboratory

This is dedicated to some advance instrumentation and control techniques. As mechanical systems and the operations of which are mostly dynamic and complex, these are required for a more accurate and precise physical data acquisition, system diagnostics, simulation, design, and failure analysis and prediction. This laboratory serves the instrument calibration as well as the material testing needs of the industry and other institution.

Instrumentation, Robotics, and Controls Laboratory

The laboratory focuses on control theory and system dynamics, and caters to the robotics and electromechanical needs of the department. Although it primarily functions as a teaching lab, it occasionally serves as a venue for student projects and research activities. Aside from Lego® educational sets, the laboratory houses a variety of National Instruments™ products, enabling the quicker implementation of different robotics and control theory concepts.

Power Laboratory

This laboratory houses several apparatus and systems such as micro steam power plant, dynamometer, and turbo machinery. Running these systems allow the students to master the principles and the concerns in the generation, transmission, and utilization of heat and mechanical power.

UPME Design and Manufacturing Center

Housed in the German Yia II Hall (IE/ME Building), the UPME Manufacturing and Design Center came into being to serve the following needs:

- instruction of students and trainees in the use of computer-controlled and manually-controlled machine tools and other equipment dedicated to metals and materials processing and handling
- fabrication services
- product design and prototyping

The center is home to industrial-grade state-of-the-art machinery such as numerically-controlled machine tools as well as conventional machine tools, modern metal cutting and welding equipment.

Vehicle Research and Testing Laboratory

The Vehicle Research and Testing Laboratory (VRTL) was established by grants from the Department of Science and Technology (DOST) and Department of Energy (DOE) and inaugurated in 2008. Envisioned to

be a national laboratory, it is tasked with conducting engine/vehicle performance and emissions testing both in the laboratory and on-road. The VRTL conducts technology assessment of aftermarket automotive products related to engine/vehicle performance and emissions. Studies on fuel economy and emissions of alternative fuels/biofuels have been performed by the VRTL to assist government policy formulation and implementation in these areas. Since becoming operational, the laboratory has supported multi-disciplinary undergraduate and graduate research work of local and foreign students with its capabilities. The VRTL, with its engine and chassis dynamometers, is gearing for more applied and fundamental studies on engine/vehicle performance and emissions.

8.7 EXTENSION SERVICES

The Department of Mechanical Engineering also provides services to various individuals and organizations from industry. The services offered by the department are listed below.

Testing / Calibration / Consultancy / Expert Advice/ Training and Seminars which include the following:

- Automotive Technology
- Coal Burning Technologies
- Computer Aided Design
- Design Optimization
- Energy Management
- Equipment Engineering
- Fuel Cell Technology
- Heat and Air Flow Design
- Heating, Ventilation, Air Conditioning and Refrigeration
- Maintenance Management and Industrial Safety
- Machine Design
- Manufacturing
- Mass Metrology
- Power Plant Design, Operation and Maintenance
- Propeller Design
- Pump Design and Applications
- Solid Waste Management

8.8 FACULTY AND STAFF

The Department of Mechanical Engineering has nineteen faculty members, a significant number of whom have Ph.D. and/or M.S. degrees. The Department encourages, and sometimes even sponsors its junior faculty members to take further studies in order to broaden their knowledge in the field they choose to specialize in.

Department Chair

Asst. Prof. Ralph S. Jose

Professors

Ferdinand G. Manegdeg
M.S. Combustion and Energy
University of Leeds, 1981
Combustion, Power Plant, HVAC, Energy Policy, Systems and Productivity Improvement

Andre S. Publico
Ph.D. Engineering Mechanics (Bioengineering)
Columbia University, 2000
Biomechanics, Computational Mechanics, Geometric Morphometrics

Associate Professors

Menandro S. Berana
Dr. Eng. Mechanical Engineering
Toyohashi University of Technology, 2009
Shock Waves, Multi-Phase Flow, Power and Refrigeration Systems, Refrigerants

Louis Angelo M. Danao
Ph.D. Mechanical Engineering
University of Sheffield, 2012
Wind and Tidal Energy Turbine Design, Structural Analysis and Machine Design, Biomechanics, CFD and FEA Modelling

Gerald Jo C. Denoga
M.S. Mechatronics Engineering
University of New South Wales, 2003
Mechatronics, Control Systems, HVACR, Vehicle Engineering

Edwin N. Quiros
Ph.D. Energy Engineering
University of the Philippines Diliman, 1989
Energy Systems, Fuels, Internal Combustion Engines

Assistant Professors

Juvy A. Balbarona
M.S. Mechanical Engineering
University of the Philippines Diliman, 2012
Thermal Sciences

Ralph S. Jose
M.S. Mechanical Engineering
University of the Philippines Diliman, 2014
Design and Manufacturing, Computer Aided Design, CAM/CNC

Jose Gabriel E. Mercado
M.S. Mechanical Engineering
University of the Philippines Diliman, 2015
Biofuels and Automotive Engineering

Joseph Gerard T. Reyes
Ph.D. Environmental Engineering
University of the Philippines Diliman, 2015
Machine Design, Energy and Environmental Engineering, Facilities Management

Paul L. Rodgers
M.S. Naval Architecture
Kyushu University, 1993
Naval Architecture

Ervin S. Santos
M.S. Mechanical Engineering
University of the Philippines Diliman, 2016
Metrology, Automotive Engineering

Instructors

Binoe E. Abuan
B.S. Mechanical Engineering
University of the Philippines Diliman, 2013
Machine Design and Hydrodynamics, HVACR

Samiel Louie M. Arrojado
B.S. Mechanical Engineering
University of the Philippines Diliman, 2011
Control Systems

Jon Dewitt E. Dalisay
B.S. Mechanical Engineering
University of the Philippines Diliman, 2014
Engineering Design

Hannah Erika R. Ducusin
B.S. Mechanical Engineering
University of the Philippines Diliman, 2011
Computer Integrated Manufacturing

Jennifer J. Fabular
B.S. Mechanical Engineering
University of the Philippines Diliman, 2011
Machine Design

John Carlo S. Garcia
B.S. Mechanical Engineering
University of the Philippines Diliman, 2012
Thermal Sciences, Heating, Ventilation, Air-Conditioning and Refrigeration

Koshneir S. Jimenez
B.S. Mechanical Engineering
University of the Philippines Diliman, 2015
Machine Design and Transportation Engineering

Professorial Lecturer

Manuel V. Hernandez, Jr.

Lecturer

Jose Ygnacio Jesus A. Macaspac V.

Shop Lecturer

Oriel H. Borres

Administrative Staff

Jocelyn B. Avendaño
Brian R. Gerodias

Laboratory Staff

Romeo B. Boncocan
Jose C. Cano
Conrado C. Dela Rosa
Nonelon B. Donaire
Benjamin T. Hipolito
Jaime R. Implica
John D. Laquindanum
Domingo M. Rafin
Cayetano C. Zalazar

CONTACT INFORMATION

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8.9 UNDERGRADUATE PROGRAM CURRICULUM

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING†

First Year

First Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units	Second Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units
GE (AH 1) Eng 10 (College English)	3	0	3	GE (AH 2) Comm 3 (Pract Speech Fund)	3	0	3
GE (SSP 1) Kas 1[1] (Kasaysayan ng Pil)	3	0	3	Math 53 (Elementary Analysis I)	5	0	5
GE (SSP 2) Philo 1 (Philo Analysis)	3	0	3	Physics 71 (Elementary Physics I)	4	0	4
GE (MST 1) Free Choice [3]	3	0	3	Physics 71.1 (Elem Physics I Lab)	0	3	1
Math 17 (Algebra and Trigonometry)	5	0	5	Chem 16 (General Chemistry I)	3	6	5
PE [4] (Physical Education)			(2)	PE [4] (Physical Education)			(2)
	17	0	**17**		15	9	**18**

Second Year

First Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units	Second Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units
GE (AH 3) Fil 40[1] (Wika, Kultura at Lip)	3	0	3	GE (SSP 3) Free Choice	3	0	3
GE (AH 4) Free Choice [2]	3	0	3	GE (AH 5) Free Choice [2]	3	0	3
Math 54 (Elementary Analysis II)	5	0	5	Math 55 (Elementary Analysis III)	3	0	3
Physics 72 (Elementary Physics II)	4	0	4	Physics 73 (Elementary Physics III)	4	0	4
Physics 72.1 (Elem Physics II Lab)	0	3	1	Physics 73.1(Elem Physics III Lab)	0	3	1
ES 1 (Engineering Drawing)	0	6	2	ES 11 (Statics of Rigid Bodies)	2	3	3
PE [4] (Physical Education)			(2)	PE [4] (Physical Education)			(2)
NSTP [5] (National Service Training Program)			(3)	NSTP [5] (National Service Training Program)			(3)
	15	9	**18**		15	6	**17**

Third Year

First Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units	Second Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units
GE (SSP 4) Free Choice	3	0	3	GE (MST 2) STS (Science, Tech & Society)	3	0	3
GE (SSP 5) Free Choice	3	0	3	ES 13 (Mech of Deformable Bodies I)	3	0	3
ES 12 (Dynamics of Rigid Bodies)	2	3	3	ES 15 (Mechanics of Fluids)	3	0	3
ES 21 (Math Methods in Engineering)	3	0	3	ME 41 (Mechanisms)	2	3	3
ES 26 (Intro to Computer Programing)	2	3	3	ME 73 (Mech Measurement & Instrument'n)	2	3	3
ME 63 (Thermodynamics)	2	3	3	ME 91 (Numerical Methods for ME)	2	3	3
	15	9	**18**		15	9	**18**

Fourth Year

First Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units	Second Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units
GE (MST 3) Free Choice [3]	3	0	3	IE 3 (Intro to Industrial Engineering)	3	0	3
MetE 143 (Elements of Materials Sci)	3	0	3	ME 122 (Fluid Machinery)	3	0	3
ME 131 (Manufacturing Processes)	3	3	4	ME 136 (Machine Tool Operations)	2	3	3
ME 142 (Kinematics & Dynamics of Mach)	2	3	3	ME 143 (Mechanical Vibrations)	2	3	3
ME 153 (Machine Design I)	3	0	3	ME 154 (Machine Design I)	3	0	3
ME 165 (Internal Combustion Engines)	3	0	3	ME 164 (Fund of Heat & Mass Transfer)	2	3	3
	17	6	**19**		15	9	**18**

Fifth Year

First Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units	Second Semester	Lect (hrs/wk)	Lab (hrs/wk)	Units
CE 22 (Engineering Economy)	3	0	3	PI 100 (The Life & Works of Jose Rizal)	3	0	3
EEE 1 (Essentials of E&E Engineering)	3	3	4	ME 177 (Control Systems II)	3	0	2
ME 155 (Machine Design III)	0	6	3	ME 180 (Inspection Trips & Seminars)	3	0	2
ME 176 (Control Systems I)	3	0	3	ME 188 (Power Plant Engineering)	3	0	4
ME 183 (Refrig & Air-Conditioning)	3	0	3	ME 192 (Industrial E&E Equipment)	1	6	3
Elective 1	3	0	3	Elective 2 [6]	3	0	3
	15	9	**19**		16	6	**17**

Total Number of Units = **179**

Notes:

† *Effective Academic Year 2012-2013. Total Number of units = 179*

[1] Kas 1 and Fil 40 satisfy the 6-unit Philippine Studies requirement

[2] Nine (9) units of GE (AH) courses must be in Communication in English

[3] Except for Math 1, GE (MST) Math, Physics, Chem, Geol, ES, GE, EEE cannot be credited as GE courses

[4] For physical education (PE), the student is required to complete any 4 physical education (PE) courses

[5] As a requirement for graduation, all students must take six (6) units in one of the National Service Training Program (NSTP) components: Civic Welfare Training Service (CWTS), Literacy Training Service (LTS), and Reserved Officer's Training Corps Military Science (ROTC Mil Sci)

[6] With department approval

8.10 GRADUATE PROGRAM CURRICULUM

MASTER OF SCIENCE IN MECHANICAL ENGINEERING (M.S. ME)

PROGRAM CHECKLIST

Total Minimum Units Required: 30 units

Course Number	Title	Units
	Core Courses (6 units minimum)	**6**
ME 258	Advanced Machine Design	3
ME 267	Advanced Thermodynamics I	3
ME 260	Advanced Heat Transfer I	3
ME 242	Intermediate Mechanisms	3
	Applied Mathematics (6 units minimum)	**6**
ES 201	Advanced Mathematical Methods in Engineering I	3
ES 202	Advanced Mathematical Methods in Engineering II	3
ES 204	Numerical Methods in Engineering	3
	Electives (12 units minimum)	**12**
CE 201	Matrix Theory of Structures	3
CE 226	Structural Dynamics	3
ES 230	Continuum Mechanics I	3
ES 231	Continuum Mechanics II	3
ES 233	Theory of Stability	3
ES 250	Similitude in Engineering	3
ES 251	Intermediate Fluid Mechanics	3
ES 252	Hydrodynamics	3
ES 253	Advanced Fluid Mechanics	3
EgyE 231	Energy Economics and Systems Evaluation	3
EgyE 232	Energy Systems Modeling and Design	3
ME 222	Fluid Machinery and Systems	3
ME 224	Design of Fluid Machinery and Systems	3
ME 226	Gas Dynamics	3
ME 231	Metal Cutting and Forming	3
ME 236	Tool Engineering	3
ME 242	Intermediate Mechanisms	3
ME 243	Advanced Mechanisms	3
ME 258	Advanced Machine Design	3
ME 259	Composite Materials	3
ME 260	Advanced Heat Transfer I	3
ME 264	Advanced Heat Transfer II	3
ME 267	Advanced Thermodynamics I	3
ME 268	Advanced Thermodynamics II	3
ME 281	Advanced Refrigeration	3
ME 282	Advanced Air-Conditioning	3
ME 286	Combustion	3
ME 287	Fuels and Thermal Power	3
ME 296	Seminar	1
ME 298	Special Problems	3
MSE 251	Mechanical Properties of Solids	3
MSE 255	Metal Casting	3
	Cognate (Other Engineering courses with Department Approval)	3
	Thesis (6 units)	
ME 300	Thesis	**6**
	Total	**30**

8.11 UNDERGRADUATE PROGRAM COURSE DESCRIPTIONS

Mechanical Engineering (ME)

ME 10 Survey of Manufacturing Processes. Mechanical manufacturing processes: casting, hot and cold forming; sheet metal work; machining; joining. Chemical manufacturing processes: material handling; size reduction and classification; separation of fluids, solids, and gases. Materials and processes in the packaging of integrated circuits in plastic and ceramic packages. Plant visits. Prereq: 3rd yr. standing. 3 u.

ME 41 Mechanisms. Introduction to types of mechanisms and mobility. Linkages. Cams. Spur, bevel, helical and worm gearing. Gear train analysis and assembly. Synthesis of planar mechanisms. Prereq: ES 1, Math 53. 5 h (2 class, 3 lab) 3 u.

ME 63 Thermodynamics. First and second laws of thermodynamics. Properties of thermodynamic media. Ideal gases. Thermodynamic cycles. Prereq: Physics 72, Math 54. 3 u.

ME 73 Mechanical Measurement and Instrumentation. Fundamentals of mechanical measurements. Design and execution of experiments; statistical analysis and analysis of experimental data. Calibration of measuring instruments. Prereq: ME 63; Coreq: ES 15. 5 h (2 class, 3 lab) 3 u.

ME 91 Numerical Methods for Mechanical Engineers. Numerical computation for linear and non-linear equations. Eigenvalue, initial-value and boundary value problems. Numerical solutions to ordinary and partial differential equations. Introduction to the Finite Element Method. Prereq: ES 21, ES 26. 5 h (2 lec, 3 lab) 3 u.

ME 101 Mechanical Equipment for Buildings. Principles and operation of mechanical equipment such as airconditioners, elevators, dehumidifiers, pumps, and exhaust fans. 3 u.

ME 122 Fluid Machinery. Principles and operation of rotodynamic fluid machines such as turbines, fans, blowers, pumps, and compressors. System design and equipment selection. Prereq: ES 15. 3 u.

ME 126 Aerodynamics of the Airplane. Air foils. The airplane and its components. Forces acting on the airplane. Propulsion systems. Performance and stability. Prereq: ES 15. 3 u.

ME 131 Manufacturing Processes. Principles in metal production. Pattern making and foundry processes. Cold and hot working, welding, brazing, soldering, and riveting. Materials production. Projects. Plant visits. Prereq: 4th yr. standing; Coreq: MetE 143. 6 h (3 lec, 3 lab) 4 u.

ME 136 Machine Tool Operations. Principles and processes in metal cutting, forming and fabrication. Safety in shop operations. Projects. Prereq: 4th yr. standing; Coreq: MetE 143. 5 h (2 lec, 3 lab) 3 u.

ME 142 Kinematics and Dynamics of Machinery. Position, velocity and acceleration analysis of mechanisms. Force analysis of mechanisms. Engine dynamics. Balance of machinery. Prereq: ES 12, ME 41. 5 h (2 class, 3 lab) 3 u.

ME 143 Mechanical Vibrations. Introduction to mechanical vibrations. Types of vibrations. Multi-degree of freedom systems. Vibrations in Continuous Systems. Vibration Control. Instrumentation for vibration measurement. Experiments. Prereq: ES 21, ME 142. 5 h (2 lec, 3 lab) 3 u.

ME 153 Machine Design I. Topics in mechanics of materials such as two-dimensional and three-dimensional state of stress, multi-plane bending and combined loading, built-up and composite sections, curved beams, compression members, thick and thin walled pressure vessels, deflection analysis, theories of failure for static and fatigue loading. Prereq: ES 13; Coreq: Met E 143. 3 u.

ME 154 Machine Design II. Design and analysis of machine elements such as fasteners, welds, springs, bearings, gears, shafts, brakes, clutches and flexible mechanical elements. Prereq: ME 41, ME 153. 3 u.

ME 155 Machine Design III. Projects in analysis and design of machine elements and mechanical equipment. Prereq: ME 143, 154. 6 h. (lab) 2 u.

ME 164 Fundamentals of Heat and Mass Transfer. Principles of heat and mass transfer. Conduction, convection, radiation and phase-change heat transfer. Mass transfer in gases, liquids and solids. Heat exchangers and their applications. Prereq: ME 63, ME 91. 5 h (2 lec, 3 lab) 3 u.

ME 165 Internal Combustion Engines. Principles of internal combustion engine operation. Cycle analysis. Fuels and fuel metering. Combustion in spark-ignition and compression-ignition engines. Engine friction, lubrication, and cooling. Engine design, performance, and emissions characteristics. Prereq: ME 63. 3 u.

ME 176 Control Systems I. Mathematical modelling of physical systems, system response characteristics. Analysis and design of continuous control systems. Prereq: ES 21, ME 73. 5 h (2 lec, 3 lab) 3 u.

ME 177 Control Systems II. Alternative methods of mathematical modelling of physical systems. Analysis and design using advanced methods. Frequency response techniques and design. Discrete control systems. Prereq: ES 21, ME 73, ME 176. 2 u.

ME 180 Inspection Trips and Seminars. Visits to factories, power plants, utility companies, shops and related installations. Technical reports and projects in line with the above. Prereq: 5th yr. standing. 6 h (lab) 2 u.

ME 183 Refrigeration and Air-Conditioning. Standard vapor compression cycle, components, system analysis and balance. Psychrometry, air conditioning processes, cooling load and heating load calculations, fan and duct design, cooling coils and heat exchanger design. Alternative refrigeration systems. Prereq: ME 164. 6 h (3 lec, 3 lab) 4 u.

ME 188 Power Plant Engineering. Fundamentals in power generation and power plant technology. Power plant cycles and methods employed to improve cycle efficiency. Plant components and subsystems. Equipment reliability. Load curves, utilization factors and determination of plant capacity. Variable load operation. Non-fossil fuel power plants. Renewable sources of energy. Considerations in plant design and equipment selection. Environmental effects of power stations. Prereq: ME 122, ME 164, ME 165. 6 h (3 lec, 3 lab) 4 u.

ME 192 Industrial Electrical and Electronic Equipment. Electromechanical energy conversion and associated equipment. Actuators and transducers. Theory and characteristics of electrical equipment. Associated devices and circuits for their protection and control. Applications in power and industrial systems. Modern control devices in industry. Prereq: EEE 1. 5 h (2 lec, 3 lab) 3 u.

ME 197 Special Topics. Prereq: COI. 3 u.; may be taken twice, topics to be indicated for record purposes.

ME 198 Special Problems. Prereq: COI. 3 u.

Shop Practice (SP)

SP 1 Hand Tools. Exercises in material processing using hand and light power tools such as hammers, chisels, hand drills, saws, files, etc. 3 h (lab) 1 u.

SP 3 Machine Tools. Exercises in machining operations with the use of lathes, shapers, milling machines, and other machine tools. Prereq: ME 131. 3 h (lab) 1 u.

SP 4 Welding, Foundry, and Allied Practices. Exercises in pattern making, core making, molding and metal casting, welding and allied processes. Prereq: ME 136. 3 h (lab) 1 u.

SP 5 Pattern-Making, Welding, and Foundry Practice. An abridged combination of Shop Practice 1 and 4. 3 h (lab) 1 u.

SP 6 Machine Work. The abridgement of Shop Practice 3. 3 h (lab) 1 u.

SP 7 General Shop Practice. The use of equipment for machining, welding, casting and allied practices. 3 h (lab) 1 u.

8.12 GRADUATE PROGRAM COURSE DESCRIPTIONS

Mechanical Engineering (ME)

ME 211 Safety Engineering. Principles and practice of industrial safety and accident prevention. Local laws on industrial safety. 3 u.

ME 222 Fluid Machinery and Systems. Fluid mechanics and thermodynamics of turbomachinery. Transient analysis and fluid flow. Prereq: ME 122. 3 u.

ME 224 Design of Fluid Machinery and Systems. Design of turbines, blades and vanes, propellers, pumps and fluid machinery systems. Prereq: ME 122. 5 h (2 class, 3 lab) 3 u.

ME 226 Gas Dynamics. The fluid mechanics of compressible flow. Shock phenomena. Hodograph method. Method of characteristics. Supersonic flow. Prereq: ME 63. 3 u.

ME 231 Metal Cutting and Forming. Mechanics of metal cutting and forming. Factors affecting metal working. Advances in the field. Prereq: ME 136. 3 u.

ME 236 Tool Engineering. Design and analysis of dies, jigs, fixtures, hand tools and machine tools. Prereq: ME 155. 3 u.

ME 242 Intermediate Mechanisms. Kinematics of planar motion. Approximate and multiply-separated-position synthesis of planar mechanisms. Graphical and analytical methods in synthesis. Prereq: ME 142. 3 u.

ME 243 Advanced Mechanisms. Analysis and synthesis of spatial mechanisms. Motion and geometric considerations in the design of pair elements. Prereq: ME 242. 3 u.

ME 258 Advanced Machine Design. Special topics in stress and strain analysis. Optimization in the design of machine elements. Statistical considerations in design. Projects. Prereq: ME 155. 3 u.

ME 259 Composite Materials. Properties and mechanics of composite materials. Stiffness, compliance and strength of fibers, lamina and laminates. Prereq: ME 153. 3 u.

ME 260 Advanced Heat Transfer I. Transient conduction and convection. Multi-phase systems. Exact and appropriate solutions. Boundary layer problems. Prereq: ES 201, ME 64. 3 u.

ME 264 Advance Heat Transfer II. Radiation heat transfer in absorbing and non-absorbing media. Shape factors. Thermal radiation from gases and flames. Solar energy. Prereq: ES 201, ME 64. 3 u.

ME 267 Advanced Thermodynamics I. Thermodynamics of unsteady flow processes. Entropy, availability and reversibility. Thermodynamics of compressible flow. Prereq: ME 63. 3 u.

ME 268 Advanced Thermodynamics II. Thermodynamic relations. Thermodynamic equilibrium. Real gases. Statistical thermodynamics. Prereq: ME 267. 3 u.

ME 281 Advanced Refrigeration. Processes, cycles and systems. Design problems and special applications such as low temperature systems, liquefaction and production of industrial gases. Prereq: ME 181. 3 u.

ME 282 Advanced Air-Conditioning. Psychrometry. Thermal comfort. Load profiles. System analysis and design. Prereq: ME 182. 3 u.

ME 286 Combustion. Theoretical and experimental analyses of combustion and explosion processes. Detonation waves. Ignition, propagation and stability of flames. Combustion calculations. Prereq: ME 187. 3 u.

ME 287 Fuels and Thermal Power. Characteristics of gaseous, liquid and solid fuels. Indigenous fuels. Combustion of fuels in furnaces, kilns, gas producers, engines and other thermal devices. Fuel treatment. Prereq: ME 187 or ME 188. 3 u.

ME 296 Seminar. 1 u. per semester; maximum of 3 u.

ME 298 Special Problems. 3 u.; may be taken twice, topics to be indicated for record purposes.

ME 300 Thesis. 6 u.