COLLEGE OF ENGINEERING AND TECHNOLOGY

(ALEXANDRIA)

GRADUATE STUDIES:

(Addendum)

Master of Engineering Programs

(M.Eng.)

2009
M.Eng. in Mechanical Engineering

OVERVIEW

Mechanical Engineering is concerned with the development and use of new technologies and the design of new processes and products, which mainly involve 'things that move', such as motor vehicles, aircraft systems, engines, pumps, gas turbines, industrial plants, air conditioning/ refrigeration systems, manufacturing processes, building services, oil and gas industries and even space stations.

The Master of Engineering program in Mechanical Engineering offers high quality education that prepares students for advanced academic, research and professional careers in one of the following specializations: Power and Energy, Refrigeration and Air Conditioning, Automotive and Mechatronics.

Design is the backbone of the program. Within the program, graduates will obtain the knowledge of design, engineering science courses, thermodynamics, fluid mechanics, machine dynamics, mechatronics, and materials.

The objectives of the Master of Engineering Degree in Mechanical Engineering are to provide the graduates of the program with:

- A broad knowledge of modern computational and experimental methods in engineering.
- Extensive knowledge in one of the following specializations: Power and Energy, Refrigeration and Air Conditioning, Automotive, and Mechatronics.
- Deep understanding of the research techniques and data analysis in the area of specialization.
- Ability to solve unstructured engineering problems, think critically, function well in a team, and communicate effectively.
- A high standard of written and oral communication on technical matters.
Program Detailed Structure
### M.Eng. in Mechanical Engineering

**Division (A): Mechanical Engineering**

### Master's Courses

#### CORE COURSES:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 711</td>
<td>Research Methods in Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 731</td>
<td>Advanced Heat and Mass Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ME 753</td>
<td>Advanced Computational Methods</td>
<td>3</td>
</tr>
<tr>
<td>ME 761</td>
<td>Advanced Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>4 Courses * 3 Credit Hours</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

#### ELECTIVE COURSES:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 721</td>
<td>Theory of Combustion</td>
<td>3</td>
</tr>
<tr>
<td>ME 722</td>
<td>Thermal Power Plants</td>
<td>3</td>
</tr>
<tr>
<td>ME 723</td>
<td>Renewable Energy</td>
<td>3</td>
</tr>
<tr>
<td>ME 732</td>
<td>Advanced Air Conditioning and Refrigeration</td>
<td>3</td>
</tr>
<tr>
<td>ME 751</td>
<td>Vibrations and Noise Control</td>
<td>3</td>
</tr>
<tr>
<td>ME 752</td>
<td>Robotics and Applications</td>
<td>3</td>
</tr>
<tr>
<td>ME 754</td>
<td>Simulation and Modeling of Mechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 762</td>
<td>Piping Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 763</td>
<td>Engineering Experimentations and Measurements</td>
<td>3</td>
</tr>
<tr>
<td>ME 771</td>
<td>Advanced Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>ME 781</td>
<td>Advanced Automotive Technology</td>
<td>3</td>
</tr>
<tr>
<td>ME 785</td>
<td>Automotive Maintenance</td>
<td>3</td>
</tr>
<tr>
<td>ME 791</td>
<td>Advanced Mechatronics Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 795</td>
<td>Embedded Control of Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>ME 796</td>
<td>Design for Manufacturability</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>6 Courses * 3 Credit Hours</strong></td>
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</table>
## M.Eng. in Mechanical Engineering

### Program Structure

**Division (A): Mechanical Engineering**

### Applied Research:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ME 799</td>
<td>Applied Research</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtotal</th>
<th>6 Credit Hours</th>
<th>6</th>
</tr>
</thead>
</table>

| Total       |                       | 36           |

Total Credit Hours: 36
### Mechanical Engineering Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 791</td>
<td>Advanced Mechatronics Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 793</td>
<td>Condition Monitoring and Diagnostic Expert Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 794</td>
<td>Robots Design and Applications</td>
<td>3</td>
</tr>
<tr>
<td>ME 795</td>
<td>Embedded Control of Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>ME 796</td>
<td>Design for Manufacturability</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>3 Courses * 3 Credit Hours</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

### Electronics and Communications Engineering Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC 731-M</td>
<td>Principles of Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EC 732-M</td>
<td>Advanced Electronic Measurements</td>
<td>3</td>
</tr>
<tr>
<td>EC 738-M</td>
<td>Advanced Electronic Systems</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>2 Courses * 3 Credit Hours</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

### Computer Engineering Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC 715</td>
<td>Advanced Programming Applications</td>
<td>3</td>
</tr>
<tr>
<td>CC 724</td>
<td>Computer Architecture and Embedded Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 734</td>
<td>Computer Communications</td>
<td>3</td>
</tr>
<tr>
<td>CC 744</td>
<td>Data Acquisition Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 751</td>
<td>Applications of Artificial Neural Networks</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>2 Courses * 3 Credit Hours</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

continued/…
**M.Eng. in Mechanical Engineering**

**Program Structure**

Division (B): Mechatronics Engineering

.../continued

### ELECTRICAL AND CONTROL ENGINEERING COURSES:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 713</td>
<td>Digital Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>EE 715</td>
<td>Optimal Control</td>
<td>3</td>
</tr>
<tr>
<td>EE 751</td>
<td>Power Electronic Devices and their Applications</td>
<td>3</td>
</tr>
<tr>
<td>EE 752</td>
<td>Automated Industrial Systems</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>3 Courses * 3 Credit Hours</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

### APPLIED RESEARCH:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 799</td>
<td>Applied Research</td>
<td>6</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>6 Credit Hours</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

**Total**                                                 **36**
Courses

Detailed Structure
Course Code : ME 711
Course Title : Research Methods in Mechanical Engineering
Credit Hours : 3

Course Description
The course provides graduate students with an overall understanding of the nature of academic research. Research design, qualitative and quantitative research, sources of data. Data collection procedures, measurement strategies and results analysis. Evaluating and writing research report. Error analysis. Presentation skills.

Course Objectives
To provide an understanding of the main research methods used in Mechanical engineering and develop the necessary knowledge and skills for pursuing research projects, theses or dissertations.

Course Topics
- Nature of Mechanical Engineering Research
- Formulation of research problem
- Literature review and technical writing
- Research methods and research design
- Statistical analysis: parametric and non-parametric techniques, regression and factor analysis.
- Advanced statistical topics
- Modeling techniques, optimization, simulation, and IT applications in research
- Research validation
- Error Analysis
- Presentation skills

References
Course Code : ME 721
Course Title : Theory of Combustion
Credit Hours : 3

Course Description
Broad survey and principle to fuels and combustion technology. Also, combustion systems as applied to engineering, selection and design of combustion systems. Delineate the fundamentals of combustion engines emission and their control. Case study projects and laboratory activities.

Course Objectives
The student should be able to:

- Understand the fundamentals and applications of combustion technology
- Understand the problem of energy conservation and improvement of combustion efficiency
- Understand the selection and design of a specified combustion system
- Understand the combustion safety and air pollution problem
- Understand the special combustion challenges for aeronautical and space development

Course Topics
- Principle to fuels and combustion technology
- Combustion system as applied to engineering
- Selection and design of combustion systems
- Case study projects and laboratory activities

References
- D. J. Patterson, N. A. Henein, “Emission from Combustion Engines and their Control”, Butterworth Group, Michigan, 1982
Course Code : ME 722
Course Title : Thermal Power Plants
Credit Hours : 3

Course Description

Course Objectives
The student should acquire the state of the art of thermal power plants and power plants strategies.

Course Topics
- Steam generators design. Cold startup
- Efficient generation of steam. Failure analysis
- Maintenance and preventive maintenance
- Water treatment. Advanced technology. Pollution control
- Steam turbines. Steam turbine components
- Turbine losses. Turbine efficiencies
- Turbine performance at varying loads
- Operating turbines. Turbine maintenance
- Upgrade opportunities for system turbines. Bearing and seals
- Governors. Gas turbines. start up procedures
- Advances in material technology
- Cooling techniques. Gas turbine stall
- Advanced gas turbine design. Combined cycles
- Different kinds of combined cycles
- Design of waste heat recovery boilers. Advanced combined cycles
- Combined cycles retrofit. Comparison of power producing technologies

References
- Modern Power Station Practice (8 volumes).
- Central Electricity Generating Board - Pergamon Press LTD.
- The NALCO guide to bailer failure analysis.
Course Code : ME 723
Course Title : Renewable Energy
Credit Hours : 3

Course Description
Alternative energy sources and sustainable energy sources. Cost-benefit analysis on each form of alternative energy in order to determine what is practical on a large scale, as well as on the scale of the individual homeowner. The efficiency of each alternative energy source as well as what limitations exist in terms of extracting usable energy. The solar energy, wind, tides, hydroelectric, ocean currents, and geothermal.

Course Objectives
The student should be able to:

- Gain an understanding of the cost-benefit ratio of various alternative energy sources to see what is feasible on the large scale and what is not.
- Understand some of the various obstacles associated with actual implementation of production line alternative energy facilities.
- Do simple calculations regarding the cost of energy usage and the required infrastructure to deliver a certain amount of power.

Course Topics
- Alternative energy sources and sustainable energy sources.
- Cost-benefit analysis on each form of alternative energy in order to determine what is practical on a large scale, as well as on the scale of the individual homeowner.
- The efficiency of each alternative energy source as well as what limitations exist in terms of extracting usable energy.
- The solar energy, wind, tides, hydroelectric, ocean currents, and geothermal

References
- Boyle, Godfrey, Renewable Energy: Power For A Sustainable Future
- Lecture Notes
- Internet Sources.
Course Code : ME 731
Course Title : Advanced Heat and Mass Transfer
Credit Hours : 3

Course Description

Course Objectives
The student should be able to deal with any advanced thermodynamics problem.

Course Topics
- Three dimensional time-dependent heat transfer
- Graphical method
- Finite difference method
- Finite difference solution
- Convection
- Convection
- Radiation heat transfer
- Mass transfer
- Mass transfer
- Diffusion in liquids, solids and gases
- Mass transfer coefficients
- Magneto fluid dynamics systems
- Low density heat transfer
- Heat pipe
- Special topics assigned to students
- Special topics assigned to students

References
- Balhr, Hans Dieter “Heat and Mass Transfer”
Course Code : ME 732
Course Title : Advanced Air Conditioning and Refrigeration
Credit Hours : 3

Course Description
Introduction, Non vapor compression systems, Cryogenics, Building management systems, Industrial air ventilation, Duct design, balancing and control, Hourly load estimation, Hourly based cooling load calculation. HVAC and Refrigeration software applications. Solving variable cooling load problems and system design.

Course Objectives
The student should be able to:

- Apply the advanced principles of refrigeration and air conditioning
- Design any refrigeration and air conditioning system

Course Topics
- Absorption refrigeration systems
- Absorption refrigeration systems
- Absorption refrigeration systems
- Thermoelectric refrigeration systems
- Thermoelectric refrigeration systems
- Thermoelectric refrigeration systems
- Cryogenics. Indoor air quality
- Cryogenics. Indoor air quality
- Cryogenics. Indoor air quality
- Cryogenics. Indoor air quality
- Space air diffusion
- Space air diffusion
- Space air diffusion
- Building air distribution
- Building air distribution
- Building air distribution

References
- ASHRAE, Applications
- ASHRAE, Fundamentals
- Stocker W. F. “Refrigeration and Air Conditioning”
Course Code: ME 751
Course Title: Vibration and Noise Control
Credit Hours: 3

Course Description

Course Objectives
The student should be able to:

- Present comprehensive coverage of the fundamental principles of vibration theory, with emphasis on the application of these principles to practical engineering problems.
- Help the students understand how the vibrations are of great importance to various engineering systems and gain experience in their design and development.
- Facilitate comparison of theoretical and experimental results and to help carrying out further studies to control noise and vibrations.

Course Topics
- Introduction
- Response of nonharmonic excitation
- Continuous systems
- Multidegree of freedom systems
- Vibration control
- Vibration measurements
- Typical vibration problems
- Acoustic concepts
- Noise control
- Machinery noise
- Design of mufflers and barriers

References
Course Code : ME 752
Course Title : Robotics and Applications
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:

- Apply the kinematics, dynamics and control of manipulators from both theoretical and practical points of view.
- Design and analyze systems involving manipulators in various engineering applications.

Course Topics
- Differential relationships.
- Manipulator dynamics.
- Inverse dynamics.
- Static forces.
- Compliant motion.
- Manipulator control.
- Programming.

References
- Nakamura Y. “*Advanced Robotic Redundancy and Optimization*”, Addison, Wesley.
- Craigs, “*Introduction to Robotics*”, Addison, Wesley.
- Asada H. and Toumi, K. “*Direct Drive Robot*ic”, Cambridge University, Press.
Course Code : ME 753
Course Title : Advanced Computational Methods
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:
- Develop ability to use personal computers to solve advanced problems in mechanical engineering.
- Write and/or use computer software to numerically solve a variety of problems.

Course Topics
- Error analysis
- Solution of non-linear algebraic equations
- Numerical integration
- Numerical solution of ordinary differential equations (ODEs) for the initial value problem
- Solution of systems of ODEs
- The stiff ODEs
- The solution of the boundary value problem using the linear shooting, finite difference, and non-linear shooting methods
- Applications to Mechanical, hydraulic, and thermal system design
- The finite difference approximation
- Numerical solution of partial differential equations (PDEs) using the finite difference method
- Applications on elliptic, parabolic, and hyperbolic PDEs
- Direct and iterative methods of solution
- Solution of PDEs using the finite volume method. Solution of PDEs using the finite element method
- Applications to problems in fluid mechanics, steady and transient conduction heat transfer, elastic deformation of solid elements, and stress analysis
- Case studies using the MATLAB programming and available software and modules

References
Course Code: ME 754
Course Title: Simulation and Modeling of Mechanical systems
Credit Hours: 3

Course Description

Course Objectives
To help students gain knowledge about model trends to combine modeling, theoretical analysis, and computer simulation.

Course Topics
- Introduction to system concepts
- Complex analysis, differential equations and Laplace transform
- Solution of PDEs using the finite element method
- System model representation
- System model representation
- Modeling of lumped mechanical systems
- Modeling of lumped mechanical systems
- Electrical, Electronic and Electromechanical systems
- Electrical, Electronic and Electromechanical systems
- Fluid and thermal systems
- System response
- High order Systems in closed form
- High order Systems in closed form
- State variables
- Dynamic system simulation for MATLAB, SIMULINK, (Modeling, Simulation and Implementation)
- Dynamic system simulation for MATLAB, SIMULINK, (Modeling, Simulation and Implementation)

References
Course Code : ME 761
Course Title : Advanced Fluid Mechanics
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:

- Acquire good understanding and deep insight into the different types of fluid flows.
- Design, analyze and solve any problem in the field of fluid flows and related topics.

Course Topics
- General equations of motion of viscous fluid
- Exact solutions of the Navier Stokes equations
- Flow at small Reynolds number
- The laminar boundary layer theory
- Non-steady boundary layers
- Boundary layer control
- Transition and turbulent boundary layers
- Analysis of theoretical and experimental data
- Case studies and design problems encountered in various fluid flows and related fields

References
- H. Versteeg and W. Malalasekera. An Introduction to Computational Fluid Dynamics.
Course Code : ME 762
Course Title : Piping Systems
Credit Hours : 3

Course Description
Introduction and background to Fluid Power. Types of control valves and their applications including the servo and proportional valves. Hydraulic systems design and operation including the hydraulic accumulators and intensifiers. Hydraulic systems maintenance and troubleshooting.

Course Objectives
- To provide an in-depth background in the field of hydraulic systems, covering design, analysis, operation and maintenance.
- To acquire a thorough knowledge of the characteristics of all hydraulic components, especially the different types of control valves.
- To completely understand the functions and operation of the components of hydraulic systems to be designed and then will be able to design and analyze the hydraulic system.

Course Topics
- Introduction and background to Fluid Power
- Types of control valves and their applications including the servo and proportional valves
- Hydraulic systems design and operation including the hydraulic accumulators and intensifiers
- Hydraulic systems maintenance and troubleshooting

References
Course Code : ME 763
Course Title : Engineering Experimentations and Measurements
Credit Hours : 3

Course Description

Course Objectives
- To provide an in-depth background in the basic measurements techniques and uncertainty analysis.
- Acquire a thorough knowledge of the characteristics of flow meters, velocity meters and pressure measuring devices.
- Understand the functions and operation of the flow meters, velocity meters as well as pressure measuring devices.
- Gain a solid understanding of the uncertainty analysis as well as experience of applying the analysis to various sets of data.

Course Topics
- Introduction and background to Fluid Power
- Types of control valves and their applications including the servo and proportional valves
- Hydraulic systems design and operation including the hydraulic accumulators and intensifiers
- Hydraulic systems maintenance and troubleshooting

References
Course Code : ME 771

Course Title : Advanced Engineering Materials

Credit Hours : 3

Course Description

Course Objectives
To cover the main topics of modifying materials structure and properties, and to provide the students with the latest developments in material technology and applications of new advanced materials.

Course Topics
- Crystal structure
- Diffusion in metals
- Solidification of metals
- Equilibrium diagrams
- Heat treatment of metal alloys
- Defects in materials.
- Strengthening of materials
- Advanced materials
- Properties and applications (ceramics, polymers, composites)
- Materials selection

References
- William D. Callister, "Materials Science and Engineering – An Introduction"
- James F. Shackelford, "Introduction to Materials Science for Engineers"
- William F. Smith, "Foundations of Materials Science and Engineering".
- Flinn and Trojan, "Engineering Materials and Their Applications"
- Mahmoud M. Farag, "Materials Selection for Engineering Design"
Course Code : ME 781
Course Title : Advanced Automotive Technology
Credit Hours : 3

Course Description
An overview of the automotive industry and technology. Basic electronics and electricity, engine performance, diagnosis and service of the systems that directly affect the drivability of a vehicle. Sensing system and diagnosis devices theory and practice. Sensor errors and functions. Engine performance also include up-to-date and through discussion on OBDII and alternative fuels. Passenger comfort and Safety, laws governing the use of refrigeration system in vehicles. The theory of heating and air conditioning systems in a vehicle. Engine testing equipments, vacuum gauge test, cylinder power balance, cylinder compression test, ignition timing, exhaust gas CO and HC analyzer, oscilloscope engine and analyzer.

Course Objectives
The student should be able to:

- Understand the basics and advanced principles of engine performance.
- Use modern diagnosis devices
- Analyze the electrical and electronic systems in vehicles.
- Become familiar with the engine test and equipments.

Course Topics
- Basic overview of the automotive industry and technology
- Basic electronics and electricity
- Engine performance, diagnosis and service of the systems that directly affect the drivability of a vehicle
- Sensing system and diagnosis devices theory and practice
- The theory of heating and air conditioning systems in a vehicle

References
Course Code: ME 785
Course Title: Automotive Maintenance
Credit Hours: 3

Course Description
Overview of automotive technology, careers, tools, diagnostic equipments, and basic automotive systems. Predictive and protective maintenance, reliability maintenance. Comprehensive guide to the service and repair of contemporary automobiles. Engine subsystems diagnostic and service procedure, wheel alignments, air conditioning, steering systems, brake systems and engine sensors and actuators. Electronic service system and spare parts. Flat rate system and job card cycle.

Course Objectives
The student should be able to:

- Understanding the principle of the predictive and protective maintenance
- Dealing with engine main subsystem in servicing and repairing
- Dealing with the sensors and actuators in the vehicles.
- Dealing with the electronic software to management the vehicle maintenance
- Understating the job card cycle and the flat rate systems.

Course Topics
- Overview of automotive technology, careers, tools, diagnostic equipments, and basic automotive systems.
- Predictive and protective maintenance, reliability maintenance
- Comprehensive guide to the service and repair of contemporary automobiles
- Engine subsystems diagnostic and service procedure, wheel alignments, air conditioning, steering systems, brake systems and engine sensors and actuators
- Electronic service system and spare parts. Flat rate system and job card cycle

References
Course Code : ME 791
Course Title : Advanced Mechatronics Systems
Credit Hours : 3

Course Description
Foundational concepts in Mechatronics and Mechatronics Systems including analog and digital electronics. Basic electronic circuits, logic gates, encoders/decoders, DC and stepper motors, A/D and D/A conversion, sensors, actuators, microprocessors, and microprocessor interfacing to electromechanical systems. Combining hardware and software into integrated mechatronic systems. Hands-on laboratory experiments with components and measurement equipment used in the design of mechatronic products.

Course Objectives
The student should be able to:

- Understand the basic principles of Mechatronics.
- Analyze Mechatronic Systems and combine hardware and software into integrated typical Mechatronic Systems.
- Develop hands-on laboratory experience with components and measurement equipment.

Course Topics
- Foundational concepts in Mechatronics and Mechatronics Systems including analog and digital electronics
- Basic electronic circuits
- Logic gates
- Encoders/decoders
- DC and stepper motors
- A/D and D/A conversion
- Sensors – Actuators - Microprocessors
- Microprocessor interfacing to electromechanical systems
- Combining hardware and software into integrated mechatronic systems
- Hands-on laboratory experiments with components and measurement equipment used in the design of mechatronic products

References
- Necsulescu, Dan, “Mechatronics”, Prentice-Hall.

Course Code : ME 793
Course Title: Condition Monitoring and Diagnostic Expert Systems
Credit Hours: 3

Course Description

Course Objectives
The student should be able to:
- Understand the main concepts of condition monitoring techniques.
- Understand the components and functions of engineering expert systems.
- Use available expert system for condition monitoring

Course Topics
- Condition monitoring definition and overview.
- Equipment and system failures
- Techniques of predicting failures
- Vibration measurement and analysis
- Infrared thermography
- Oil analysis and tribology
- Ultrasonics
- Motor current analysis
- Equipment and component reliability
- Equipment optimization
- Engineering Expert Systems
- The architecture and characteristics of expert systems
- Applications of engineering expert systems
- Classic and contemporary examples
- Laboratory activities

References
- J. H. Williams, Alan Davies and Peter R. Drake, “Condition–Based Maintenance and Machine Diagnostics”, Amazon.
- Trevor M. Hunt, “Condition Monitoring of Mechanical and Hydraulic Plant”, Amazon.
- Trevor Hunt, “Level Leakage and Flow”
- Alan Davies, “Handbook of Condition Monitoring- Techniques and Methodology”
- “Acoustic Emission and Ultrasonic Monitoring Handbook”
- “Noise and Acoustics Monitoring Handbook”

Course Code: ME 794
Course Title: Robots Design and Applications
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:

- Apply the kinematics dynamics and control of manipulators from both theoretical and practical points of view.
- Apply control processes and algorithms to the design of manipulators and robots.
- Use robots to solve problems in various engineering applications.

Course Topics
- Introduction and basic concepts in robotics
- Components and subsystems
- Robots applications
- Homogeneous transformations.
- Kinematics’ equations
- Manipulator position and manipulator motion
- Differential relationships
- Motion trajectories.
- Dynamics.
- Mobile robots.
- Sensors, measurements and perception
- Control
- Programming

References
- Nakamura Y. “*Advanced Robotic Redundancy and Optimization*”, Addison, Wesley.
- Craigs, “*Introduction to Robotics*”, Addison, Wesley.
- Asada H. and Toumi, K. “*Direct Drive Robot*”, Cambridge University, Press.
Course Code: ME 795

Course Title: Embedded Control of Manufacturing Processes

Credit Hours: 3

Course Description
Development of general concepts for control of the manufacturing processes. Introduction to the concepts of and tools for process modeling, process optimization, and process control. Presentation of an integrated approach combining statistical process control (SPC) and traditional automatic process control (APC) theory.

Course Objectives
The student should be able to:

- Understand the concepts of the control of manufacturing processes.
- Apply process control techniques to typical problems and case studies.

Course Topics
- Development of general concepts for control of the manufacturing processes
- Introduction to the concepts of and tools for process modeling, process optimization, and process control
- Presentation of an integrated approach combining statistical process control (SPC) and traditional automatic process control (APC) theory

References
Course Code : ME 796
Course Title : Design for Manufacturability
Credit Hours : 3

Course Description
Principles and practice of design and manufacturability with emphasis on Mechatronics, design parameters, manufacturing techniques, reliability, design for quality, assembly and environmental considerations, case study projects and laboratory activities.

Course Objectives
The student should be able to deal with advanced manufacturing techniques.

Course Topics
- Development of general concepts for control of the manufacturing processes
- Introduction to the concepts of and tools for process modeling, process optimization, and process control
- Presentation of an integrated approach combining statistical process control (SPC) and traditional automatic process control (APC) theory

References
Course Code : CC 715
Course Title : Advanced Programming Applications
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:
- Understand the main features of the C- programming language.
- Design and write computer programs for complex systems.
- Develop software skills in the design and analysis employing the C- programming language.

Course Topics
- Semantics of programming languages.
- Data types.
- Control structures.
- Object-oriented methodology.
- Programming.
- Methods and techniques.
- C-Programming language.
- File processing:
  - Text files.
  - Random access files,
  - File application projects
  - Recursion.
  - Sorting and searching.
  - Applications using graphics.
  - Applications using graphics.

References
- IEEE Transactions on Software Engineering
Course Code: CC 734
Course Title: Computer Communications
Credit Hours: 3

Course Description

Course Objectives
The student should be able to acquire a unified overview of the broad field of data and computer communications. The course emphasizes the basic principles and topics of fundamental importance concerning the technology and architecture of this field and provides a detailed discussion.

Course Topics
- Introduction to computer communication networks.
- Fundamental Concepts of data communication.
- Layered network architecture and network protocols.
- Integrated service networks and quality of service.
- The internet protocol and the asynchronous transfer mode.
- Fundamental concepts of wireless networks and network security.

References
Course Code : CC 724
Course Title : Computer Architecture and Embedded Systems
Credit Hours : 3

Course Description
Problems in hardware, firmware (micro-program), and software. Computer architecture for resource sharing, real-time applications, parallelism, micro-programming, and fault tolerance. Micro-operations, instruction sets, CPU design, memory and input/ output organizations. Various architectures based on cost performance, area and timing constraints.

Course Objectives
The course introduces the students to the design principles associated with non Von Neumann architectures. Moreover, the students are introduced to special-purpose machine design.

Course Topics
- Problems in hardware.
- Firmware (micro-program); and software
- Computer architecture for resource sharing
- Real-time applications
- Parallelism
- Micro-programming, and fault tolerance
- Micro-operations, instruction sets, CPU design, memory and input/ output organizations. Fundamental concepts of wireless networks and network security.
- Various architectures based on cost performance, area and timing constraints

References
- J. Henkel and S. Parameswaran, Designing Embedded Processors: A Low Power Perspective. 2007
- Deszso Sima et al., Advanced Computer Architectures, Addison Wesley, 1997
Course Code: CC 744
Course Title: Data Acquisition Systems
Credit Hours: 3

Course Description

Course Objectives
To develop microprocessor ROM applications with the PC, create portable applications for field data acquisition, and program interfaces to instruments, experiments and processes.

Course Topics
- Data Acquisition, Definitions and Applications.
- Sensors and transducers: types, applications, structural classifications
- Signal conditioning.
- Amplifications, reshaping and filtration. Data conversion, principles, devices and limitations.
- Introduction to data analysis and elementary control.
- Case studies.
- Student projects.

References
- Omega Instrumentation, Reference Year Book, V. 127.
Course Code : CC 751
Course Title : Applications of Artificial Neural Networks
Credit Hours : 3

Course Description
This course allows the introduction of material relating to current artificial neural networks (ANN) research topics, and current advances in ANN technology. Topics include: network architectures, learning rules, linear transformations, Hebian learning, performance optimization, Widro-Hoff learning, back-propagation, competitive networks, Hopfield networks, stability, and, Adaptive resonance theory, and hardware implementation of ANN.

Course Objectives
To understand the simple abstractions of biological neurons, realized as elements in a program or perhaps a circuit made of silicon, the concepts of mathematical background and their applications in various areas

Course Topics
- This course allows the introduction of material relating to current artificial neural networks (ANN) research topics, and current advances in ANN technology
- Topics include: network architectures, learning rules, linear transformations
- Hebian learning, performance optimization.
- Widro-Hoff learning, back-propagation, competitive networks, Hopfield networks, stability
- Adaptive resonance theory and hardware implementation of ANN.

References
Course Code: EC 731-M
Course Title: Principles of Digital Signal Processing
Credit Hours: 3

Course Description
Introduction. Definition of signals, sources of signal, signal conditioning, applications of DSP. Analog signal processing, amplification, filtering, clipping and clamping. Data converters, sampling of signals, DAC’s, ADC’s. Frequency transformations, DFT, FFT. Digital filtering, Recursive Df, Non-recursive Df.

Course Objectives
To be acquainted with signal processing techniques at large with special emphasis on digital processing of signals. Getting familiar with the tools and practical applications of DSP.

Course Topics
- Introduction.
- Definition of signals, sources of signal, signal conditioning, applications of DSP
- Analog signal processing, amplification, filtering, clipping and clamping.
- Fundamental Concepts of data communication.
- Analog signal processing, amplification, filtering, clipping and clamping.
- Data converters, sampling of signals, DAC’s, ADC’s.
- Frequency transformations, DFT, FFT.
- Digital filtering, Recursive Df, Non-recursive Df.

References
- Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing"
Course Code : EC 732-M
Course Title : Advanced Electronic Measurements
Credit Hours : 3

Course Description

Course Objectives
To be acquainted with industrial electronic measurement systems, their components, and construction. Typical systems like data acquisition systems and telemetry are then given with examples on nuclear reactors, intensive care units and telemetry.

Course Topics
- Introduction.
- Transducers.
- Sensors.
- Data Acquisition Systems.
- Telemetry

References
Course Code: EC 738-M
Course Title: Advanced Electronic Systems
Credit Hours: 3

Course Description
Introduction. Power supply systems, basic power supply system, voltage regulators, stabilized power supplies, uninterruptible power supply systems. Photovoltaic power systems. Basics of telecommunication systems, telephony, radio and TV broadcasting systems, TV cameras and monitors, microphones and loudspeakers. Micro Electro-Mechanical Systems (MEMS), principle, types, applications.

Course Objectives
To become familiar with some key electronic systems such as conventional power supplies, UPS and non conventional power sources like solar cells units.

Course Topics
- Introduction.
- Power supply systems:
  - basic power supply system,
  - voltage regulators,
  - stabilized power supplies,
  - uninterruptible power supply systems.
- Photovoltaic power systems.
- Basics of telecommunication systems, telephony, radio and TV broadcasting systems, TV cameras and monitors, microphones and loudspeakers.
- Micro Electro-Mechanical Systems (MEMS):
  - principle,
  - types,
  - applications.

References
- "Handbook of Advanced Electronic and Photonic Materials and Devices."
Course Code : EE 713  
Course Title : Digital Control Systems  
Credit Hours : 3  

Course Description  

Course Objectives  
The student should be able to:  

- Define the digital system and its performance.  
- Use a digital controller and design a digital one.  
- Differentiate between digital and analog controllers.  

Course Topics  
- Review to systems analysis using the z-transform.  
- Discrete system modeling.  
- State space representation.  
- Controllability and observability.  
- Digital controllers.  
- Observers.  
- Introduction to optimal control.  

References  
Course Code : EE 715
Course Title : Optimal Control
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:

- Learn the graduate optimization techniques and its application in control systems
- Apply optimization techniques in control systems and to use computer to optimize the controller

Course Topics
- Review of unconstrained optimal control problems.
- Constrained mathematical programming.
- Variation problems.
- Maximum principle.
- Computer methods in optimal control.
- Geometric optimization.

References
Course Code : EE 751
Course Title : Power Electronic Devices and their Applications
Credit Hours : 3

Course Description

Course Objectives
The student should be able to:

- Choose the power electronic device suitable for the nature of the application.
- Understand the control circuitry associated with power electronic devices.

Course Topics
- Characteristics of Power diodes, Power MOSFETs, Thyristors and IGBTs.
- Gate drive signal generation.
- Signal coupling through pulse transformers and opto-couplers.
- Gating.
- Applications
- Selection of power electronic devices suitable for machine rating.
- DC and AC drive.
- ADC and DAC applications in drive circuits.
- Construction of logic circuits based on position sensing

References
Course Code : EE 752
Course Title : Automated Industrial Systems
Credit Hours : 3

Course Description
Automation hierarchical levels and components. Detecting sensors and actuating elements. Introduction to PLCs. Types of PLCs and construction. Hardware configuration and descriptions. Programming and testing basic functions. Programming and testing advanced functions. Industrial Applications using PLCs.

Course Objectives
The student should be able to:
- Investigate the different topics of structures of automated systems
- Provide the basics of programmable logic controllers
- Study behavior of PLC in industrial applications

Course Topics
- Automation hierarchical levels and components.
- Detecting sensors and actuating elements.
- Introduction to PLCs. types of PLCs and construction.
- Hardware configuration and descriptions
- Programming and testing basic functions
- Fundamental concepts of wireless networks and network security.
- Industrial Applications using PLCs.

References