ARAB ACADEMY FOR SCIENCE, TECHNOLOGY
AND MARITIME TRANSPORT

COLLEGE OF ENGINEERING
AND TECHNOLOGY

( GRADUATE STUDIES )

# Master of Science Programs

# STATUS REPORT

ALEXANDRIA

2012

# MECHANICAL ENGINEERING

M.SC. PROGRAMS

# M.Sc. 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 Science 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 Science 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.
- An 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.Sc. Programs

# M.Sc. in Mechanical Engineering

## DIVISION (A): MECHANICAL ENGINEERING

### Master's Courses

## CORE COURSES:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| ME 711 | Research Methods in Mechanical Engineering | 3 |
| ME 731 | Advanced Heat and Mass Transfer | 3 |
| ME 753 | Advanced Computational Methods | 3 |
| ME 761 | Advanced Fluid Mechanics | 3 |
| **Subtotal** | **4 Courses * 3 Credit Hours** | **12** |

## ELECTIVE COURSES:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| ME 721 | Theory of Combustion | 3 |
| ME 722 | Thermal Power Plants | 3 |
| ME 723 | Renewable Energy | 3 |
| ME 732 | Advanced Air Conditioning and Refrigeration | 3 |
| ME 751 | Vibrations and Noise Control | 3 |
| ME 752 | Robotics and Applications | 3 |
| ME 754 | Simulation and Modeling of Mechanical Systems | 3 |
| ME 762 | Piping Systems | 3 |
| ME 763 | Engineering Experimentations and Measurements | 3 |
| ME 771 | Advanced Engineering Materials | 3 |
| ME 781 | Advanced Automotive Technology | 3 |
| ME 785 | Automotive Maintenance | 3 |
| ME 791 | Advanced Mechatronics Systems | 3 |
| ME 795 | Embedded Control of Manufacturing Processes | 3 |
| ME 796 | Design for Manufacturability | 3 |
| **Subtotal** | **4 Courses * 3 Credit Hours** | **12** |

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## RESEARCH THESIS:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| ME 701 | Master's Research Thesis (Part 1) | 6 |
| ME 702 | Master's Research Thesis (Part 2) | 6 |
| **Subtotal** | **2 Parts * 6 Credit Hours** | **12** |

| | |
|---|---|
| **Total** | **36** |

# M.Sc. in Mechanical Engineering

## DIVISION (B): MECHATRONICS ENGINEERING

### MECHANICAL ENGINEERING COURSES:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| ME 791 | Advanced Mechatronics Systems | 3 |
| ME 793 | Condition Monitoring and Diagnostic Expert Systems | 3 |
| ME 794 | Robots Design and Applications | 3 |
| ME 795 | Embedded Control of Manufacturing Processes | 3 |
| ME 796 | Design for Manufacturability | 3 |
| **Subtotal** | **2 Courses * 3 Credit Hours** | **6** |

### ELECTRONICS AND COMMUNICATIONS ENGINEERING COURSES:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| EC 731-M | Principles of Digital Signal Processing | 3 |
| EC 732-M | Advanced Electronic Measurements | 3 |
| EC 738-M | Advanced Electronic Systems | 3 |
| **Subtotal** | **2 Courses * 3 Credit Hours** | **6** |

### COMPUTER ENGINEERING COURSES:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| CC 715 | Advanced Programming Applications | 3 |
| CC 724 | Computer Architecture and Embedded Systems | 3 |
| CC 734 | Computer Communications | 3 |
| CC 744 | Data Acquisition Systems | 3 |
| CC 751 | Applications of Artificial Neural Networks | 3 |
| **Subtotal** | **2 Courses * 3 Credit Hours** | **6** |

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## ELECTRICAL AND COMPUTER CONTROL ENGINEERING COURSES:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| EE 713 | Digital Control Systems | 3 |
| EE 715 | Optimal Control | 3 |
| EE 751 | Power Electronic Devices and their Applications | 3 |
| EE 752 | Automated Industrial Systems | 3 |
| **Subtotal** | **2 Courses * 3 Credit Hours** | **6** |

## RESEARCH THESIS:

| Course Code | Course Title | Credit Hours |
|---|---|---|
| ME 701 | Master's Research Thesis (Part 1) | 6 |
| ME 702 | Master's Research Thesis (Part 2) | 6 |
| **Subtotal** | **2 Parts * 6 Credit Hours** | **12** |

| | |
|---|---|
| **Total** | **36** |

# Courses

# Course 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


- Tan, W. "*Practical Research Methods*" Pearson Prentice Hall, New York, 2004.
- Cramer, D. "*Advanced Quantitative Data Analysis*" Open University Press, McGraw-Hill Education, 2003.
- Bryman, A. and Cramer, D. "Qu*antitative Data Analysis with SPSS Release 12.0*", Routledge, London, 2004.
- Sree Ramulu, U. S. "*Thesis Writing*" – Oxford and IBH Publishing, New Delhi, India. 1988.
- John R. Taylor, *An Introduction to Error Analysis- The study of uncertainties in physical Measurements*", USA, 1982.

**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


- S. P Sharma, C. Mohan, "*Fuels and Combustion*," McGraw Hill, 1982
- D. B. Spalding, "*Combustion and Mass Transfer*," Pergamon Press, Oxford, 1983
- N. A. Chigier, "*Progress in Energy and Combustion Science*", Pergamon Press, Oxford, 1986
- A. M. Kanury, "*Introduction to Combustion Phenomena*", Gordon and Breach Science Publishers, New York, 1979
- T. M. Williams, "*Combustion Theory*", Addision-Wasley, 1973
- D. J. Patterson, N. A. Henein, "*Emission from Combustion Engines and their Control*", Butterworth Group, Michigan, 1982
- C. R. Croswell, "*Notes on Air Pollution Control*", H.K. Kowis, London, 1978

**Course Code :** ME 722

**Course Title :** Thermal Power Plants

**Credit Hours :** 3

## Course Description

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.

## 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 useable 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 useable energy
- The solar energy, wind, tides, hydroelectric, ocean currents, and geothermal Convection

## References

- Sorensen, Bent, *Renewable Energy: Its Physics, Engineering, Use, Environmental Impacts, Economy And Planning Aspect*.
- Boyle, Godfrey, *Renewable Energy: Power For A Sustainable Future*
- Lecture Notes
- Internet Sources.

# Course Detailed Structure



**Course Code :** **ME 731**

**Course Title :** **Advanced Heat and Mass Transfer**

**Credit Hours :** **3**

## Course Description

Three dimensional time-dependent heat transfer. Graphical method. Finite difference method. Finite difference solution. Convection. Radiation heat 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.

## 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


- Mills, A.F. "*Heat and Mass Transfer,*" Irwin, Chicago. 1995
- Incropera, Frank P. "*Fundamentals of Heat and Mass Transfer*," Wiley, New York, 1990
- Holman, J.P. "*Heat Transfer*," McGraw Hill, New York.
- Eastop. "*Applied Thermodynamics*," Longman, Singapore. 1993
- 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 Detailed Structure



**Course Code :** **ME 751**

**Course Title :** **Vibration and Noise Control**

**Credit Hours :** **3**

## Course Description

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.

## Course Objectives

The student should be able to:

- Present comprehensive coverage of the fundamental principles of vibration theory, with emphasis on the application of theses 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
- Response of nonharmonic excitation
- Continuous systems
- Continuous systems
- Multidegree of freedom systems
- Multidegree of freedom systems
- Vibration control
- Vibration measurements.
- Vibration measurements.
- Typical vibration problems.
- Acoustic concepts
- Noise control
- Machinery noise
- Design of mufflers and barriers
- Design of mufflers and barriers

## References


- Singiresu S. Rao, "*Mechanical Vibrations*", Addison Wesley, 1995.
- M.L. JAMES, G.M. SMITH, J.C. WOLFORD and P.W. WHALEY, "*Vibration of Mechanical and Structural Systems*", Harper and Row, Publishers, New York, 1989.
- William T. Thomson, "*Theory of Vibration with Applications*", Prentice Hall, 1993.

**Course Code :** ME 752

**Course Title :** Robotics and Applications

**Credit Hours :** 3

## Course Description

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

## 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


- Yoshikawa T. *Advanced robotics, Analysis and control*, Cambridge MIT Press
- Koren Y. "*Robotics for Engineering*", McGraw-Hill.
- Nakamura Y. "*Advanced Robotic Redundancy and Optimization*", Addison, Wesley.
- Craigs, "*Introduction to Robotics*", Addison, Wesley.
- Asada H. and Toumi, K. "*Direct Drive Robotic*", Cambridge University, Press.

# Course Detailed Structure



**Course Code :** ME 753

**Course Title :** Advanced Computational Methods

**Credit Hours :** 3

## Course Description

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.

## 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


- Smith W. "*Numerical Solution of Partial Differential Equations*", Oxford Univ. Press, 1990
- Versteeg H. and Malalasekera W. "*An Introduction to Computational Fluid Dynamics*" The finite volume method, Longman Scientific and Technical, 1995
- Anderson J. D. "*Computational Fluid Dynamics: The Basics with Applications*", McGraw Hill, 1995
- Nakamura S. "*Numerical Analysis and Graphic Visualization with MATLAB*", Prentice Hall, 1996
- Burden F. "*Numerical methods*", PWS Pub. Co., 1997
- Coombes K. R. "*Differential Equations with MATLAB*", John Wiley, 2000

# Course Detailed Structure



**Course Code :** **ME 754**

**Course Title :** **Simulation and Modeling of Mechanical systems**

**Credit Hours :** **3**

## Course Description

Introduction to system concepts. Complex analysis, differential equations and Laplace transform. System model representation. Modeling of lumped mechanical systems. Electrical, Electronic and Electromechanical systems. Fluid and thermal systems. System response. High order Systems in closed form. State variables. Dynamic system simulation for MATLAB, SIMULINK, (Modeling, Simulation and Implementation).

## 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


- Cochin and W. Cadwallender, "*Analysis and Design of Dynamic Systems*", Addison Wesley, 1997.
- Hung V. Vu and Ramin S. Esfandiari, "D*ynamic Systems, Modeling and Analysis*", McGraw-Hill, 1998.
- *Dynamic System Simulation for MATLAB*, Prentice-Hall, 1998.

**Course Code :** ME 761

**Course Title :** Advanced Fluid Mechanics

**Credit Hours :** 3

## Course Description

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.

## 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. Shlichting. *Boundary Layer Theory*. McGraw Hill
- L. Rosenhead. *Laminar Boundary Layers*. Oxford at Clarendon Press.
- H. Versteeg and W. Malalasekera. *An Introduction to Computational Fluid Dynamics*.
- *The Finite Volume Method*. Longman Scientific and Technical.

**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

- Michael J. Pinches and John G. Ashby, "*Power Hydraulics*", Prentice Hall, 1989.
- Hugh Martin, "*The Design of Hydraulic Components and Systems*", Ellis Horwood, Ltd., 1995.
- Anthony Esposito, "*Fluid Power with Application*", Prentice-Hall, 6th ed., 2002.
- Richard J. Michell and John J. Pippenger, "*Fluid Power Maintenance Basics and Troubleshooting*", Marcel Dekker, Inc., 1997.

**Course Code :** ME 763

**Course Title :** Engineering Experimentations and Measurements

**Credit Hours :** 3

## Course Description

Basic principles of measurements. Uncertainty analysis. Differential pressure meters. Rotating mechanical flow meters. Volumetric flow meters. Volumetric flow meters. Choosing the right flow meters. Fluid velocity measuring instruments. Pressure devices and measurements.

## 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

- Thomas G. Beckwith, Roy D. Marangoni and John H. Lienhard V, "*Mechanical Measurements*", Addison-Wesley, Inc., 1993.

# Course Detailed Structure



**Course Code :** ME 771

**Course Title :** Advanced Engineering Materials

**Credit Hours :** 3

## Course Description

Crystal structure, a review. 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.

## 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. Shakelford, "*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 Detailed Structure



**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


- Robert Bosch GMbH, *Automotive Electrics; Automotive Electronics*, 4th ed., Automotive Technology, Germany, 2004
- Heisler, H, *Advanced Engine Technology*, Butterworth-Heinemann, UK, 2001
- Heisler, H, *Advanced Vehicle Technology*, 2nd ed., Butterworth-Heinemann, UK, 2001
- Robert Bosch GMbH, *Diesel-Engine Management*, Automotive Technology, Germany, 2004.
- Robert Bosch GMbH, *Gasoline-Engine Management*, Automotive Technology, Germany, 2004.
- Stone, R and Ball, J, K, *Automotive Engineering Fundamentals*, SAE, USA, 2004
- Erjavec, J, *Automotive technology*, 3rd Ed., Delmar Thomson, USA, 2000.
- Robert Bosch GMbH, *Automotive handbook*, 6th edition, Germany, 2004.

**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


- Robert Bosch GMbH, *Automotive Electrics; Automotive Electronics*, 4th edition, Automotive Technology, Germany, 2004
- Heisler, H, *Advanced Engine Technology*, Butterworth-Heinemann, UK, 2001
- Heisler, H, *Advanced Vehicle Technology*, 2nd edition, Butterworth-Heinemann, UK, 2001
- Robert Bosch GMbH, *Gasoline-Engine Management*, Automotive Technology, Germany, 2004
- Erjavec, J, *Automotive Technology*, 3rd Edition, Delmar Thomson Learning, USA, 2000
- Robert Bosch GMbH, *Automotive Handbook*, 6th edition, Germany, 2004

**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

- Alciator, David G., "*Introduction to Mechatronics and Measurement Systems*", McGraw-Hill. London.
- Bolton, W., "*Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering*", Pearson Education, Harlow, England.
- Mahalik, Nitaigour Premchand, "*Mechatronics: Principles, Concepts and Applications*", Tata McGraw–Hill.
- Necsulescu, Dan, "*Mechatronics*", Prentice-Hall.
- Lyshevski, Sergey E., "*Electromechanical Systems, Electric Machines, and Applies Mechatronics*", CRC Pr.

**Course Code :** ME 793

**Course Title :** Condition Monitoring and Diagnostic Expert Systems

**Credit Hours :** 3

## Course Description

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. Case studies. Laboratory activities.

## 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, "C*ondition–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 Detailed Structure



**Course Code :** **ME 794**

**Course Title :** **Robots Design and Applications**

**Credit Hours :** **3**

## Course Description

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.

## 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


- Yoshikawa T. *Advanced robotics, Analysis and Control*, Cambridge MIT Press
- Koren Y. "*Robotics for Engineering*", McGraw-Hill.
- 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 Detailed Structure



**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


- Groover, M.P., "*Automation, Production Systems and Computer-Integrated Manufacturing*", Prentice Hall, 2001
- James A. Rehg, Henry W. Kraebber, "*Computer-Integrated Manufacturing*", Pearson Education, Inc., 2005.
- Vollmann, T. E., W. L. Berry, and D.C. Whybark, "*Manufacturing Planning and Control Systems*", Homewood, 1997
- Graham, G. A., "*Automation Encyclopedia*", Society of Manufacturing Engineers, 1988
- Foston, A. L., C. L. Smith, and T. Au., "*Fundamentals of Computer-Integrated Manufacturing*," Prentice Hall. 1991.
- Hall, R. W. "*Attaining Manufacturing Excellence*", Dow Jones- Irwin, 1987
- Srikanth, M. L., and M.M. Unble. "*Synchronous Manufacturing Principles for World Class Excellence*", Southwestern Purplish Company, 1990
- Goestsch, D. L., "*Modern Manufacturing Processes*", New York: Delmars Publishers, 1991
- Rehg, J.A., "*Introduction to Robotics in CIM Systems*", Prentice Hall, 2003
- Luggen, W. W., "*Flexible Manufacturing Cells and Systems*", Prentice Hall, 1991.

# Course Detailed Structure



**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


- Groover, M.P., "*Automation, Production Systems and Computer - Integrated Manufacturing*", Prentice Hall, 2001
- James A. Rehg, Henry W. Kraebber, "*Computer-Integrated Manufacturing*", Pearson Education, Inc., 2005.
- Hill, T., "*Manufacturing Strategy*" Homewood, IL: Richard D. Irwin, 1989.
- Vollmann, T. E., W. L. Berry, and D.C. Whybark, "*Manufacturing Planning and Control Systems*", Homewood, 1997
- Boothroyb, G., and P. Dewhurst., "Pro*duct Design for Manufacture and Assembly*," Manufacturing Engineering, April 1988.
- Foston, A. L., C. L. Smith, and T. Au., "*Fundamentals of Computer-Integrated Manufacturing*," Prentice Hall, 1991.
- Rehg, J.A., "*Introduction to Robotics in CIM Systems*", Prentice Hall, 2003
- Lochner, R.H., "*Designing for Quality*", Statpower Associates, 1991.

# Course Detailed Structure



**Course Code :** CC 715

**Course Title :** Advanced Programming Applications

**Credit Hours :** 3

## Course Description

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. Searching. Sorting and searching.

## 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


- Kenneth Louden, "*Programming Languages: Principles and Practice*", 2nd ed., 2002.
- Raphael A. Finkel, "*Advanced Programming Languages Design*", Addison Wesley, 1995.
- Ravi Sethi, "*Programming Languages, Concepts and Constructs*", Addison Wesley, 2000.
- IEEE Transactions on Software Engineering
- R. C. Martine, *Agile Software Development, Principles, Patterns, and Practices*, Prentice Hall 2002.
- R. Sebesta, *Concepts of Programming Languages*, Addison Wesley, 2003.
- Peters Van Ray, Seif Haridi, *Concepts, Techniques, and Models of Computer Programming*, MIT Press, 2004.

**Course Code :** CC 734

**Course Title :** Computer Communications

**Credit Hours :** 3

## Course Description

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.

## 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

- Garcia, *Communication Networks: Fundamental Concepts and Key Architectures* 2nd ed., McGraw-Hill, 2003.

**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
- Herman Kopetz, *Real-Time systems: Design Principles for Distributed Embedded Applications*, Springer, 1997

# Course Detailed Structure



**Course Code :** CC 744

**Course Title :** Data Acquisition Systems

**Credit Hours :** 3

## Course Description

Data Acquisition, Definitions and Applications. Data Acquisition channel structure components. 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.

## 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


- Arnold, H. and Van Doren, *Data Acquisition Systems*, Reston Publishing Co., 1982.
- R. Pallas and J. G. Webster, *Sensors and Signal Conditioning*.
- Steven Grengo, *Interfacing: A Lab Approach*, Prentice Hall.
- 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

- R. Beale and T. Jackson, "*Neural computing: An Introduction*", Institute of Physics Publishing, 1990.
- J. Hertz, A Krogh and R.G. Palmer, "*Introduction to the Theory of Neural Computation*", Addison Wesley, Redwood City, CA 1992.

# Course Detailed Structure



**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


- E. C. Ifeachor and B. W. Jervis, "Dig*ital Signal Processing: A Practical Approach*," Prentice Hall, 2002.
- Steven W. Smith, "T*he Scientist and Engineer's Guide to Digital Signal Processing*"
- Saeed V. Vaseghi, "*Advanced Digital Signal Processing and Noise Reduction*," 3rd Ed., Wiley, 2006

**Course Code :** EC 732-M

**Course Title :** Advanced Electronic Measurements

**Credit Hours :** 3

## Course Description

Introduction. Transducers. Sensors. Data Acquisition Systems. Telemetry

## 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

- John P. Bently, "*Principles of Measurement Systems*," 1995, Longman Group Limited, UK.
- David E. Johnson and John L. Hilburn, "*Rapid practical Designs of Active Filters*," John Wiley, New York, 1989.

# Course Detailed Structure



**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, uninterrupted 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,
    - uninterrupted 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


- S. M. Sze, "*Semiconductor Devices: Physics and Technology*," Wiley, 1988.
- "*Handbook of Advanced Electronic and Photonic Materials and Devices*."

**Course Code :** EE 713

**Course Title :** Digital Control Systems

**Credit Hours :** 3

## Course Description

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

## 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

- F. Halsall and P.F. Lister, "*Microprocessor Fundamentals*," UCL press 1993.
- A. P. Godse, "*Advanced Microprocessor and Microcontroller*," Technical Publications Pune, 2004.

**Course Code :** EE 715

**Course Title :** Optimal Control

**Credit Hours :** 3

## Course Description

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

## 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

- G. F. Lawler, "*Optimal Control Theory for Applications*", Springer-Verlag, N.Y., 2003.
- J. B. Burl, "*Linear Optimal Control: $H_2$ and H-$\infty$ Methods*," Addison Wesley, California, 1999.

**Course Code :** EE 751

**Course Title :** Power Electronic Devices and their Applications

**Credit Hours :** 3

## Course Description

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. Current limiting circuits.

## 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

- M. H. Rashid, "*Power Electronics Circuits, Devices and Applications*," Prentice Hall, 2004.
- N. Mohan, T. Undeland and W. Robbins, "*Power Electronic Converters: Applications and Design*", Wiley, 2003.
- F.L. Luo, H. Ye and M. Rashid, "*Digital Power Electronics and Applications*", Elsevier, 2005.

# Course Detailed Structure



**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


- C. B. Gray, "*Electrical Machines and Drive Systems*", Longman, 1990.
- V. Subrahmanyam, "*Thyristor Control of Electric Drives*", Tata McGraw Hill, New Delhi, 1988.
- S. B. Dewan, G. R. Slemon and A. Sraughen, "*Power Semiconductor Drives*", Wiley, 1987

# Faculty Members

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  Renewable Energy, Absorption Air Conditioning

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  Nuclear Engineering

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