



**Al-Zaytoonah Private University of Jordan**

**Faculty of Engineering**

**Mechanical Engineering / Air  
Conditioning and Refrigeration  
Systems Engineering**

**Study plan**

**2012/2013**

# Mechanical engineering / Air Conditioning and Refrigeration Systems Engineering Curriculum

## ➤ *COURSE CODING AND NUMBERING*

- A seven-number code is used to designate courses as in the following table:

Department	Level/Year	Field	Sequence
Four -Number Code	X (Number)	Y (Number)	Z (Number)

- The Department number codes at the Faculty of Engineering are as in the following table:

Code	Department
0901	Electrical Engineering
0902	Civil Engineering
0903	Architectural Engineering and Building Systems
0904	Mechanical Engineering

Code	Department
	Industrial Engineering
	Chemical Engineering
	Nuclear Engineering

- The middle digit denotes the course subject as in the following table

Middle Digit	Specialization
0	General Topics
1	Mechanics
2	Engineering Drawing and Machine Design
3	Thermal Science
4	Energy
5	Fluids
6	Control
7	Engineering Training, Project and Selected Topics
8	
9	

Therefore, courses in Mechanical Engineering / Air Conditioning and Refrigeration Systems Engineering will have numbers of the form 0904XYZ, where the coding of X, Y and Z will be described in more detail later.

### ➤ *SPECIALIZATIONS*

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The Department of Mechanical Engineering offers the Bachelor of Science (B.Sc.) degree after successfully passing 160 credit hours. Currently the B.Sc. degree in Mechanical engineering can be obtained in the specialization of Air Conditioning and Refrigeration Systems Engineering.

### ➤ *DEGREE REQUIREMENTS*

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Classification		Credit Hours		
		Compulsory	Elective	Total
<b>University Requirements</b>	Restricted University Requirements	12	15	27
<b>Faculty Requirements</b>		26		26
<b>Department Requirements</b>	Department Core	101		101
	Specialization Elective		6	6
<b>Total =</b>		<b>139</b>	<b>21</b>	<b>160</b>

➤ **UNIVERSITY REQUIREMENTS (27 CREDIT HOURS)**

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University requirements consist of 30 credit hours split into 12 compulsory credit hours, 15 restricted elective credit hours.

○ **COMPULSORY UNIVERSITY REQUIREMENTS (12 CREDIT HOURS)**

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Course Number	Course Title	Credit	Theory	Practical	Pre-Requisite
0401100 <sup>(1)</sup>	Arabic Language I	3	3		Pass 0401099
0402100 <sup>(2)</sup>	English Language I	3	3		Pass 0402099
0409101 <sup>(3)</sup>	Military Sciences	3	3		
0409103	National Education	3	3		
Total		12			

- 1) A student who passes the Arabic Language Placement Test is exempted from **0401099** only.
- 2) A student who passes the English Language Placement Test is exempted from **0402099** only.
- 3) This course is required from Jordanian students only; graded on Pass/Fail basis. Students graduating from Royal Military faculty and military candidates school and equivalent institutes are exempted from taking this course: Non-Jordanian Arabic Speaking students are required to take a substitute for this course from the elective courses and in this case the grade of this course is included in their grade point average (GPA).

○ ***ELECTIVE UNIVERSITY REQUIREMENTS (15 CREDIT HOURS)***

The university elective courses are five courses with a total of 15 credit hours; the following table lists these courses.

University Elective Courses : 15 Credit Hours			
Field I: Human sciences			
Course Number	Course Name	Credit Hours	Pre-Requisite
0402105	English Language II	3	0402100
0403100	Modern History of Jordan	3	
0403105	History of Jerusalem	3	
0404100	Islamic Culture	3	
0407100	Physical Education	3	
Field II: Social and Economic Sciences			
Course No	Course Name	Credit Hours	Pre-Requisite
0405101	Introduction to Sociology	3	
0405102	Contemporary Issues	3	
0405104	Introduction to Psychology	3	
0407102	Principles of Education	3	
0505100	Principles of Economics	3	
Field III: Sciences, Technology, Agriculture and Health			
Course No	Course Name	Credit Hours	Pre-Requisite
0102102 <sup>(4)</sup>	Computer Skills	3	0102099
0103100	Science and Community	3	
0105101	Health and Life	3	
0106100	Fundamentals of Environment	3	
0110100	Medical Plants	3	

4. A student who passes the Computer Skills Placement Test with a grade > 50% is exempted from 0102099.

➤ **FACULTY REQUIREMENTS (26 CREDIT HOURS)**

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The Faculty of Engineering requirements consist of 26 Credit Hours distributed as follows:

Faculty of Engineering requirements					
Course Number	Course Title	Credit	Theory	Practical	Pre-/Co-Requisite
0101103	Calculus I for Engineering students	3	3	0	
0101104	Calculus II for Engineering students	3	3	0	0101103
0901230	Programming in C++ Language	3	3	0	
0103101	General Physics I	3	3	0	
0103102	General Physics II	3	3	0	0103101
0103108	General Physics Lab I for Engineering students	1	0	3	Co. 0103101
0103109	General Physics Lab II for Engineering students	1	0	3	Co. 0103102
0902231	Technical Writing	1	1	0	2 <sup>nd</sup> year Level
0904101	Engineering Workshops	2	1	3	
0904102	Engineering Drawing	3	0	6	
0904400	Engineering Economics	3	3	0	4 <sup>th</sup> year Level
	Total	26			

○ *DEPARTMENT COMPULSORY COURSES (101 CREDIT HOURS)*

Department Compulsory Courses ( 65 CREDIT HOURS)					
Course Number	Course Title	Credit	Theory	Practical	Pre-/Co-Requisite
0904200	Computer Applications	1	0	3	0102099
0904211	Dynamics	3	3	0	0902200
0904212	Strength of Materials	3	3	0	0902200
0904213	Strength of Materials Lab.	1	0	3	Co.0904212
0904214	Materials Sciences	2	2	0	0104116
0904220	Machine Drawing	1	0	3	0904102
0904231	Thermodynamics (1)	3	3	0	0103102
0904300	Numerical Methods for engineering Students	3	3	0	01012710
0904311	Mechanical Vibrations	3	3	0	0904211, 0904320
0904312	Engineering Measurements	3	3	0	0904350, 0904360
0904313	Engineering Measurements Lab.	1	0	3	Co. 0904312
0904320	Design of Machine Element	3	3	0	0904212
0904330	Thermodynamics (2)	3	3	0	0904231
0904331	Thermodynamics Lab.	1	0	3	Co. 0904330
0904350	Fluid Mechanics (1)	3	3	0	0904211 و 0101104
0904351	Fluid Mechanics Lab.	1	0	3	Co. 0904350
0904360	System Dynamics and Control	3	3	0	0904211
0904361	Control Lab.	1	0	3	Co. 0904360
0904430	Heat Transfer (1)	3	3	0	0904350
0904431	Air Conditioning and Refrigeration Systems (1)	3	3	0	0904430, 0904330
0904432	Heat Transfer Lab.	1	0	3	Co. 0904433
0904433	Heat Transfer (2)	3	3	0	0904430
0904450	Gas Dynamic	3	3	0	0904350
0904520	Design Hydraulic and Pneumatic Control Systems	3	3	0	0904350, 0904360
0904521	Design Hydraulic and Pneumatic Control Systems Lab.	1	0	3	Co. 0904520
0904530	Air Conditioning and Refrigeration Systems (2)	3	3	0	0904431
0904560	Control Application in Air Conditioning and Refrigeration	3	3	0	0904431 & 0904460
0904570	Engineering Training	8 weeks			120 cr. Hours
0904571	Final Year Project I	1	0	3	120 cr. Hours
0904572	Final Year Project II	2	0	6	0904571
	Total	65			

Department Core Courses from the Other Departments. (36 CREDIT HOURS)					
Course Number	Course Title	Credit	Theory	Practical	Pre-/Co-Requisite
0101271	Ordinary Differential Equations	3	3	0	0101104
0104116	General Chemistry for engineering students	3	3	0	
0104118	General Chemistry Lab. for engineering students	1	0	3	Co. 0104116
0101205	Calculus III For engineering students	3	3	0	0101104
0901212	Electrical and Electronics Circuits	3	3	0	0103102
0901213	Electrical and Electronics Circuits Lab.	1	0	3	0901212
0901305	Numerical Methods for engineering students	3	3	0	0101271 & 0901230
0901332	Digital Logic and PLC	3	3	0	0901212
0901342	Electrical Machines	3	3	0	0901212
0901343	Electrical Machines Lab.	1	0	3	Co. 0901342
0901361	Signal and System Analysis	3	3	0	0101271 & 0901332
0901425	Power Electronics	3	2	3	0901212
0901435	Microcontroller	3	3	0	0901332
0901461	Digital Signal Processing	3	3	0	0901361
0902200	Statics	3	3	0	0103101

○ ***ELECTIVE COURSES FOR MECHANICAL ENGINEERING/ AIR CONDITIONING AND REFRIGERATION SYSTEMS ENGINEERING***  
***(6 CREDIT HOURS FROM THE FOLLOWING TABLE\*)***

Elective Courses for Air Conditioning and Refrigeration Systems Engineering					
Course Number	Course Title	Credit	Theory	Practical	Pre-/Co-Requisite
0904522	Computer-Aided Design	3	2	3	0904320
0904534	Thermal Power Systems	3	3	0	0904330
0904543	Solar Energy	3	3	0	0904433
0904544	Green Building	3	3	0	0904330 & 0904430
0904547	Energy Conversion	3	3	0	0904530
0904551	Fluid Mechanics (2)	3	3	0	0904350
0904573	Special Topics	3	3	0	5 <sup>th</sup> year



## ➤ COURSE DESCRIPTIONS

<b>0904101</b>	<b>Engineering Workshops</b>	<b>2C,1H, 3L</b>
It covers Carpentry, Welding, electrical installations, model making through milling and lathe.		
<b><u>Pre-/Co- Requisites:</u></b>		Faculty requirements
<b>0904102</b>	<b>Engineering Drawing</b>	<b>3C,6L</b>
This course of study aims to teach students the necessary techniques of preparing engineering drawings, reading and interpreting a drawing, and solving three dimensional engineering problems that require the application of graphical analysis using computer aided design and modeling in 2 and 3 dimensions.		
<b><u>Pre-/Co- Requisites:</u></b>		Faculty requirements
<b>0904200</b>	<b>Computer Applications</b>	<b>2C,1H,3L</b>
A systematic development of programming via flowcharts and pseudo codes; The course highlights include: assignment, repetition, decision making, arrays, file processing and subprograms in program construction. Program design includes: algorithm design, procedures and data program structure, module design, programming standards, program documentation, testing, debugging, verification and validation, file organization and processing, array processing, abstract data structures, data driven programs and simulation. Matlab language will be used. Homework problems and projects of direct engineering applications will be assigned.		
<b><u>Pre-/Co- Requisites:</u></b>	0102099	Department Compulsory
<b>0904211</b>	<b>Dynamics</b>	<b>3C,3H</b>
Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems. Kinetics of particles; Newton's second law, Central force motion, Work-energy equation, Principle of impulse and momentum, Impact, Conservation of energy and momentum, Application to a system of particles. Kinematics of rigid bodies; Relative velocity and acceleration, Instantaneous center, Analysis in terms of a parameter. Plane kinetics of rigid bodies with application of Newton's second law, Energy and impulse-momentum.		
<b><u>Pre-/Co- Requisites:</u></b>	0902200	Department Compulsory
<b>0904212</b>	<b>Strength of Materials</b>	<b>3C,3H</b>
Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading, Thermal Stresses, Elementary theory of torsion, Solid and hollow shafts, Thin-walled tubes, Rectangular cross-section, Stresses in beams due to bending, shear and combined forces. Composite beams, Analysis of plane stress, Mohr's Circle, Combined stresses, Thin-walled pressure vessels, Deflection of beams, Buckling of columns, Energy Methods.		

<b><u>Pre-/Co- Requisites:</u></b>	0902200	Department Compulsory
<b>0904213</b>	<b>Strength of Materials Lab.</b>	<b>1C,3L</b>
<p>This laboratory serves mainly the measuring and/or determination of some material properties (strain and stress, yield stress, ultimate stress, fracture stress). Non destructive testing of materials (NDT), micro and macro examination of materials and phase diagrams for steel. It is equipped with machines for conducting tests, such as: Tension, impact fatigue, bending, creep, hardness, and photo elasticity tests.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	Co. 0904212	Department Compulsory
<b>0904214</b>	<b>Materials Sciences</b>	<b>2C,2H</b>
<p>Bonding forces and energies. Classification of engineering materials. Crystallography. X-ray diffraction. Imperfection in solids and strengthening mechanisms. Diffusion. Metallography. Mechanical properties of materials. Material testing evaluation and failure. Thermal equilibrium diagram. Corrosion of metals and their protection. Case studies in material selection. Relative cost of materials.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0104116	Department Compulsory
<b>0904220</b>	<b>Machine Drawing</b>	<b>1C,3L</b>
<p>Mechanical engineering drawing conventions and abbreviations, various systems of size description, including precision dimensioning, fastening elements, standard organization and preparation of engineering drawings, assembly and detailed drawings, design applications.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904102	Department Compulsory
<b>0904231</b>	<b>Thermodynamics (1)</b>	<b>3C,3H</b>
<p>Thermodynamic concepts and definitions, states, properties, systems, control volume; processes, cycles, and units; pure substances, equation of states, table of properties; work and heat; the first law, internal energy and enthalpy; conservation of mass; SSSF and USUF processes; the second law, heat engines and refrigerators, reversible processes, Carnot cycle; entropy, Clausius inequality, principle of the increase of entropy, Efficiencies.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0103102	Department Compulsory
<b>0904300</b>	<b>Numerical Methods for Engineering</b>	<b>3C,3H</b>
<p>Roots of nonlinear equations (fixed point, Newton, secant, bisection). Condition number of linear systems. Iterative methods for linear and non-linear systems (Gauss-Seidel, Gauss-Jacobi, SOR; fixed point, Newton). Interpolation and polynomial approximation. Eigenvalue methods. Spline interpolation, numerical differentiation and integration. Numerical methods for differential equations. Random number generators. Error analysis.</p>		

<b><u>Pre-/Co- Requisites:</u></b>	0101271	Department Compulsory
<b>0904311</b>	<b>Mechanical Vibrations</b>	<b>3C,3H</b>
Simple harmonic motion. Elements of vibratory systems. Systems with single degree of freedom and applications; damped free vibration, rotating and reciprocating unbalance, vibration isolation and transmissibility, and period excitation, systems with multiple degrees of freedom and applications, methods of finding natural frequencies.		
<b><u>Pre-/Co- Requisites:</u></b>	0904211, 0904320	Department Compulsory
<b>0904312</b>	<b>Engineering Measurements</b>	<b>3C,3H</b>
Report writing, basics of metrology, inspection and measurements. Errors & error analysis, uncertainty analysis, statistical methods, least squares method. Basics of transducers. Static and dynamic characteristics of systems. Measurement of flow, pressure, and temperature. Strain gauges, strain rosettes.		
<b><u>Pre-/Co- Requisites:</u></b>	0904350, 0904360	Department Compulsory
<b>0904313</b>	<b>Engineering Measurements Lab.</b>	<b>1C,3L</b>
Experimental methods on the following systems: pressure measurement, flow measurement, temperature measurement, strain gauges, strain rosettes.		
<b><u>Pre-/Co- Requisites:</u></b>	Co. 0904312	Department Compulsory
<b>0904320</b>	<b>Design of Machine Elements</b>	<b>3C,3H</b>
Review of stress, analysis. Theories of failure. Power transmission shafts. Tension and shear. Connections and selection of bolts. Helical tension and compression spring design. Weld analysis and design. Selection of rolling element bearings. Gears geometry, Force and stress analysis. Mechanical couplings. Flexible power transmission elements.		
<b><u>Pre-/Co- Requisites:</u></b>	0904212	Department Compulsory
<b>0904330</b>	<b>Thermodynamics (2)</b>	<b>3C,3H</b>
Review of basic laws and principles. Irreversibility and availability, Vapor and air power and refrigeration cycles. Mixtures of real gases and vapors. Psychrometry. Combustion. Elementary chemical kinetics		
<b><u>Pre-/Co- Requisites:</u></b>	0904231	Department Compulsory
<b>0904331</b>	<b>Thermodynamics Lab.</b>	<b>1C,3L</b>
Experimental methods in the following : Mechanical equivalent of heat; The adiabatic exponent; Marcet boiler; Bomb calorimeter; Flow through nozzle; Refrigeration system; Air conditioning system; Heat pump and air cooler; single stage air compressor; cooling tower; Thermic unit (steam turbine power plant).		
<b><u>Pre-/Co- Requisites:</u></b>	0904330	Department Compulsory

<b>0904350</b>	<b>Fluid Mechanics (1)</b>	<b>3C,3H</b>
<p>Introduction, Fluid properties, Basic units. Fluid statics, Pressure and its measurements, Forces on plane and curved submerged surfaces, buoyancy &amp; floatation, Fluids in motion, Flow kinematics and visualization, Basic control volume approach, Differential and integral continuity equation. Pressure variation in flowing fluids, Euler's and Bernoulli's equations, Applications of Bernoulli equation. Momentum principle and its applications, Navier-Stokes equations. Energy equation, Hydraulic and energy grade lines. Dimensional analysis and similitude. Surface resistance and introduction to boundary layer theory. Flow in conduits, laminar and turbulent flows, Frictional and minor losses, Piping systems.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0101104, 0904211	Department Compulsory
<b>0904351</b>	<b>Fluid Mechanics Lab.</b>	<b>1C,3L</b>
<p>Experimental methods in the following systems: center of pressure; impulse momentum principle; pumps, friction losses in pipes, stream lines and flow fields, buoyancy and boundary layer theory. Radial flow fan, Water turbine, Flow measurement.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	Co. 0904350	Department Compulsory
<b>0904360</b>	<b>System Dynamics and Control</b>	<b>3C,3H</b>
<p>Review of complex variables and Laplace transform .Poles and element transfer function and block diagram. Modeling of physical systems; electrical, mechanical, hydraulic and pneumatic systems. Linearization of nonlinear systems. System representations. Thermal, System block diagrams and signal flow graphs. Overall transfer function, block diagrams reduction techniques and Mason's gain formula. Time response analysis and performance indices of first and second order systems. Dominate poles of high order systems. Routh-hurwitz stability criterion. Stability analysis using root locus. Bode diagrams and Nyquist stability criterion. Introduction to analysis using state-space equations.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904211	Department Compulsory
<b>0904361</b>	<b>Control Lab.</b>	<b>1C,3L</b>
<p>The lab consists of experiments that are related to: First and second order system analysis control experiments. Servo systems. Stability of dynamical systems. System identification. Design and tuning of a PID controller in closed loop systems. Simulation of systems using Simulink or Matlab.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904360	Department Compulsory
<b>0904400</b>	<b>Engineering Economics</b>	<b>3C,3H</b>
<p>Applies planning, analysis, control, and engineering economic models to life cycle of physical infrastructure. Introduces infrastructure design process and application of quantitative and probabilistic models. Presents applications of model building for engineering economics; decision making; forecasting; resource scheduling and allocation; estimating; work measurement and materials; and quality and process control in water, transportation, environmental, energy, and telecommunications infrastructure systems and the built environment.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	<b>4<sup>th</sup> year</b>	Faculty requirements

<b>0904430</b>	<b>Heat Transfer (1)</b>	<b>3C,3H</b>
Introduction to modes of heat transfer; one-dimensional steady state conduction; unsteady state conduction, lumped heat capacity system; introduction to convection, flow and thermal boundary layers. Laminar and turbulent boundary layers; convection in internal and external flows; empirical relations for forced convection heat transfer; natural convection systems; condensation and boiling; introduction to thermal radiation.		
<b><u>Pre-/Co- Requisites:</u></b>	0904350	Department Compulsory
<b>0904431</b>	<b>Air Conditioning and Refrigeration Systems (1)</b>	<b>3C,3H</b>
Review of psychrometry; thermal comfort; air conditioning processes; inside and outside design conditions; heating load calculations, infiltration; cooling load calculations, solar gain; heating systems, design, layout; hot water, steam, hot air systems; under floor heating.		
<b><u>Pre-/Co- Requisites:</u></b>	0904430, 0904330	Department Compulsory
<b>0904432</b>	<b>Heat Transfer Lab.</b>	<b>1C,3L</b>
Experimental work in heat transfer covering: Measurement of thermal conductivity, Natural and forced convection, Radiation, Boiling and condensation. Heat exchangers.		
<b><u>Pre-/Co- Requisites:</u></b>	0904433	Department Compulsory
<b>0904532</b>	<b>Heat Transfer (2)</b>	<b>3C,3H</b>
Review of basic concepts; radiation properties and processes ;radiation exchange among surfaces; two dimensional steady state conduction; analytical, graphical, and numerical solutions; one-dimensional transient conduction; topics in convective heat transfer; exact and approximate problem solutions, combined entry length solution in pipe flow; heat transfer in turbulent and high speed flows; liquid metal heat transfer; freezing, melting, heat-pipe heat transfer; multimode heat transfer.		
<b><u>Pre-/Co- Requisites:</u></b>	0904430	Department Compulsory
<b>0904450</b>	<b>Gas Dynamic</b>	<b>3C,3H</b>
Basic equation of compressible flow ,wave propagation in compressible media , isentropic flow of a perfect gas , normal shock waves , oblique shock waves , prandtl-meyer flow , flow with friction , flow with heat addition .		
<b><u>Pre-/Co- Requisites:</u></b>	0904350	Department Compulsory
<b>0904520</b>	<b>Design Hydraulic and Pneumatic Control Systems</b>	<b>3C,3H</b>
The objective of this course is to familiarize student with fluid power systems design control and operation. It covers the fundamentals of fluid flow, modeling and n port concepts, fluid power modulation, static and dynamic modeling of pumps, motor, control valves, transmission lines and fluid drives. It also deals with design control and operation of mechanical and electrical hydraulic servodrives with feedback. Emphasis is placed on linear hydraulic systems behavior.		
<b><u>Pre-/Co- Requisites:</u></b>	0904350, 0904360	Department Compulsory

<b>0904521</b>	<b>Design Hydraulic and Pneumatic Control Systems Lab</b>	<b>1C,3L</b>
<p>The lab consists of experiments that are related to: fluid power systems design control and operation. Fundamentals of fluid flow, modeling and n port concepts, fluid power modulation, static and dynamic modeling of pumps, motor, control valves, transmission lines and fluid drives. It also deals with design control and operation of mechanical and electrical hydraulic servodrives with feedback. Emphasis is placed on linear hydraulic systems behavior.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904520	Department Compulsory
<b>0904522</b>	<b>Computer-Aided Design</b>	<b>3C,2H,3L</b>
<p>Fundamentals of Hardware and Software. Techniques for Geometric Modeling (Line, Surface and Volume Modeling). Elements of Interactive Computer Graphics. Entity Manipulation. Introduction to Finite Element Techniques. Using in-house software: Introduction to Graphics User Interface, Sketcher Environment, Parametric &amp; Feature-Based Solid Modeling, Surface Modeling, Concept of Parent/Child Relationships, Part Construction Techniques, Patterns, Advanced Features, Cross-Sections, Parametric Relations, Component Assembly Techniques,</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904320	Elective Course
<b>0904530</b>	<b>Air Conditioning and Refrigeration Systems (2)</b>	<b>3C,3H</b>
<p>Review of psychrometry; analysis of inside and outside design conditions; low speed air conditioning systems; cooling coils, basic cooling load analysis; by-pass systems; single duct, double and multi-duct systems; unit location and position funding; duct design, fans, energy; ventilation; control systems.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904431	Department Compulsory
<b>0904534</b>	<b>Thermal Power systems</b>	<b>3C,3H</b>
<p>Review of power cycles related to steam and gas turbine power plants; types and characteristics of steam power plants including various plant components; water treatment; corrosion; load management; power plant economics. Environmental aspects.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904330	Elective Course
<b>0904543</b>	<b>Solar Energy</b>	<b>3C,3H</b>
<p>Fundamentals of solar radiation; methods of solar radiation collection; thermal systems components and analysis; transfer of collected heat; storage of collected heat; domestic hot water system; introduction to solar energy applications.\</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904433	Elective Course

<b>0904547</b>	<b>Energy Conversion</b>	<b>3C,3H</b>
<p>Energy classification, sources and utilization; Energy growth and economics; Fossil-Fuel Systems and combustion in steam power plants. Steam generators. Boiler rating and performance.</p> <p>Environmental aspects of thermal power plants. Overview on renew-able energy sources with emphasis on solar and wind energy systems. Introduction to direct energy conversion systems; Thermoelectric, photovoltaic and thermionic converters. Energy Storage.</p>		
<b>Pre-/Co- Requisites:</b>	0904530	Elective Course
<b>0904551</b>	<b>Fluid Mechanics (2)</b>	<b>3C,3H</b>
<p>Review of basic definitions; system and control volume; Foundations of flow analysis; differential from of the basic laws; general viscous flow; boundary layer theory, Navier – Stokes equation, Blassius equation, Von Karman equation, Irrotational flow; stream function, vorticity and rotationality, Incompressible inviscid frictionless flow, 2-D Flow solutions around bodies, compressible flow; adiabatic and isentropic flow; Normal shock waves; Nozzles; Introduction to turbomachinery, centrifugal pumps</p>		
<b>Pre-/Co- Requisites:</b>	0904350	Elective Course
<b>0904560</b>	<b>Control Application in Air Conditioning and Refrigeration</b>	<b>3C,3H</b>
<p>The study of control loop theory related to commercial and industrial comfort, process and safety applications. The course focuses on analog electronic and pneumatic control components and their systems used in new and existing installations.</p> <p>The study of digital electronic control of HVAC mechanical systems to maximize their operating efficiency in commercial and industrial applications. The layout, programming and operation of the building management systems are emphasized.</p>		
<b>Pre-/Co- Requisites:</b>	0904431, 0904360	Department Compulsory
<b>0904570</b>	<b>Applied Engineering Training</b>	<b>0C</b>
<p>The student has to spend at least 8 weeks of mechanical engineering training at recognized companies and establishments during the summer semester.</p>		
<b>Pre-/Co- Requisites:</b>	<b>Passing 120 credit hours</b>	Department Compulsory
<b>0904571</b>	<b>Final Year Project I</b>	<b>1C,3L</b>
<p>A supervised project in groups of normally two students aimed at providing practical experience in some aspect of civil and infrastructure engineering. Students are expected to complete a literature survey, project specification, critical analysis, and to acquire the necessary material needed for their intended end product.</p>		
<b>Pre-/Co- Requisites:</b>	Passing 120 credit hours	Department Compulsory
<b>0904572</b>	<b>Final Year Project II</b>	<b>2C,6L</b>
<p>This is a continuity of the final project I, consequently the students are expected to successfully accomplish the final year project in the specified field of project I.</p>		
<b>Pre-/Co- Requisites:</b>	0904571	Department Compulsory

<b>0904573</b>	<b>Special Topic</b>		<b>3C,3H</b>
Vary with nature of topic. Topics of special interest to undergraduates. May be repeated for maximum 6 credits if topics are substantially different, which is subjected to departmental approval.			
<b><u>Pre-/Co- Requisites:</u></b>	5 <sup>th</sup> year	Elective Course	



## Courses for Non-ME Students

Courses for Non-ME Students		
<b>0904210</b>	<b>Engineering Mechanics</b>	<b>3C, 3H</b>
<p>Force systems; resultant, moment of a force, equivalent forcecouple system. Particle and rigid body equilibrium in one plane. Trusses and Frames. Beams; shear force and bending moment diagrams. Center of gravity and centroid. Area moment of inertia. Planar kinematics and kinetics (Newton's second Law and workenergy method) of particles and rigid bodies in rectilinear and curvilinear motion (normal and tangential coordinates).</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0103101	Non-ME
<b>0904230</b>	<b>Thermodynamics</b>	<b>3C, 2H</b>
<p>Introduces classical concepts of energy and temperature, first and second laws and their application to closed and open thermodynamic systems, covers properties of pure substances, equation of state, and analysis of thermodynamic processes, and systems, power and refrigeration cycles.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0103102	Non-ME
<b>0904310</b>	<b>Mechanical Systems</b>	<b>2C, 2H</b>
<p>mechanical systems, which include vertical and horizontal transportation systems and fire fighting systems, systems such as private yards, fountains and irrigation systems and building systems to provide hot and cold water in addition to health systems, drainage and sewage, which includes systems for supplying power and lighting and early warning anti-fire system and communications in addition to the control system and power plant system for the secondary.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904334	Non-ME
<b>0904333</b>	<b>Principles of Heating and Air Conditioning</b>	<b>3C, 2H</b>
<p>HVAC is sometimes referred to as climate control and is particularly important in the design of medium to large industrial and office buildings such as skyscrapers and in marine environments such as aquariums, where humidity and temperature must all be closely regulated while maintaining safe and healthy conditions within. The three functions of heating, ventilating, and air-conditioning are closely interrelated. All seek to provide thermal comfort, acceptable indoor air quality, and reasonable installation, operation, and maintenance costs. HVAC systems can provide ventilation, reduce air infiltration, and maintain pressure relationships between spaces. How air is delivered to, and removed from spaces is known as room air distribution.</p>		
<b><u>Pre-/Co- Requisites:</u></b>	0904230	Non-ME

<b>0904352</b>	<b>Fluid Mechanics for Non mechanical Students</b>	<b>3C, 2H</b>
Describes the laws of liquid and gas motion, atmospheric circulation, oceanic currents, flows in water and air within conduits, and various fittings. Wind loads on buildings and structures		
<b><u>Pre-/Co- Requisites:</u></b>	0103102	Non-ME
<b>0904434</b>	<b>Principles of environmental control</b>	<b>2C, 2H</b>
the basic elements of the climate, which affected the lives and comfort of humans in the environmental that exists in it and it is addressed to the temperature and humidity needed by the human in the environmental, who works and lives it through the work of the balance between external influences and their transition into the buildings . the influence of temperature and humidity, and methods of their formation and spread into the Origin is coming through the architectural elements and building materials used, so be clear to the students ways to use solar energy and the protection systems of solar radiation study of the movement of air inside buildings (ventilation) and cooling by evaporation and the time delay factor and lack of a study by traditional methods to control the heat in different climatic zones		
<b><u>Pre-/Co- Requisites:</u></b>	0904333	Non-ME
<b>0903453</b>	<b>Sanitary and waste water systems</b>	<b>3C, 3H</b>
Sanitary systems, basic definitions, water sources, properties and methods of treatment of drinking / specifications, water systems, cold and hot, design, valves, and testing of materials used in plumbing and types, sanitation, buildings (internal and external), the ventilation systems in the drainage health, drainage system, rain, fire systems in buildings.		
<b><u>Pre-/Co- Requisites:</u></b>	0904352	Non-ME

➤ **PROPOSED STUDY PLAN FOR THE B.SC. DEGREE AIR  
CONDITIONING AND REFRIGERATION SYSTEMS ENGINEERING**

**FIRST YEAR**

First Term				Second Term			
Course No.	Course Title	Credits	Pre-Requisite	Course No.	Course Title	Credits	Pre-Requisite
0402100	English Language I	3	0402099	0401100	Arabic Language I	3	0401099
0101103	Calculus I for engineering students	3		0101104	Calculus II for engineering students	3	0101103
0103101	General Physics I	3		0103102	General Physics II	3	0103101
0409103	National Education	3		0103109	General Physics Lab II for engineering students	1	Co-0103102
0904102	Engineering Drawing	3		0904101	Engineering Workshops	2	
0103108	General Physics Lab I for engineering students	1	Co-0103101	0901230	Programming in C++ Language	3	0102099
	Total	16			Total	15	

**SECOND YEAR**

First Term				Second Term			
Course No.	Course Title	Credits	Pre-Requisite	Course No.	Course Title	Credits.	Pre/Co Requisite
0101205	Calculus III for engineering students	3	0101104	0101271	Ordinary Differential Equations	3	0101104
0104116	General Chemistry for engineering students	3		0104118	General Chemistry Lab. for engineering students	1	Co. 0104116
0901212	Electrical and Electronics Circuits	3	0103102	0904212	Strength of Materials	3	0904210
0902200	Statics	3	0103101	0901213	Electrical and Electronics Circuits Lab.	1	Co. 0901212
0902231	Technical Writing	1		0904211	Dynamics	3	0904210
0904220	Machine Drawing	1	0904102	0904214	Materials Sciences	2	0104116
				0904231	Thermodynamics (1)	3	0103102
	Total	14			Total	16	

### *THIRD YEAR*

First Term				Second Term			
Course No.	Course Title	Credits	Pre-Requisite	Course No.	Course Title	Credits.	Pre/Co Requisite
0904330	Thermodynamics (2)	3	0904231	0904350	Fluid Mechanics (1)	3	0101104, 0904211
0904300	Numerical Methods for engineering students	3	0101271	0904213	Strength of Materials Lab.	1	Co. 0904212
0904331	Thermodynamics Lab.	1	Co. 0904330	0901343	Electrical Machines Lab.	1	0901342
0904320	Design of Machine Elements	3	0904212	0901332	Digital Logic and PLC	3	0901320
0901342	Electrical Machines	3	0901212	0904360	System Dynamics and Control	3	0904211
	University Elective Course	3		0901425	Power Electronics	3	0901212
					University Elective Course	3	
	Total	16			Total	17	

### *FOURTH YEAR*

First Term				Second Term			
Course No.	Course Title	Credits	Pre-Requisite	Course No.	Course Title	Credits	Pre/Co Requisite
0904351	Fluid Mechanics Lab.	1	Co. 0904350	0904521	Design Hydraulic and Pneumatic Control Systems Lab.	1	Co. 0904520
0904361	Control Lab.	1	Co. 0904360	0904441	Air Conditioning and Refrigeration Systems (1)	3	0904430, 0904331
0904312	Engineering Measurements	3	0904350, 0904360	0904313	Engineering Measurements Lab.	1	Co. 0904312
0904311	Mechanical Vibrations	3	0904211, 0904320	0904400	Engineering Economics	3	4 <sup>th</sup> Year Level
0904520	Design Hydraulic and Pneumatic Control Systems	3	0904350, 0904360	0901361	Signal and System Analysis	3	0101271, 0901332
0904430	Heat Transfer (1)	3	0904350	0904450	Gas Dynamic	3	0904350
0409103	Military Sciences	3					
	Total	17			Total	14	

***FOURTH YEAR - SUMMER ENGINEERING TRAINING***

Course No.	Course Title	Credits	Pre/Co-Requisite
0904570	Engineering Training	0	Passing 120 Credit Hours

***FIFTH YEAR***

First Term				Second Term			
Course No.	Course Title	Credits	Pre-Requisite	Course No.	Course Title	Credits.	Pre/Co Requisite
0904530	Air Conditioning and Refrigeration Systems (2)	3	0904441	0904572	Graduation Project II	2	0904571
0904560	Control Application in Air Conditioning and Refrigeration	3	0904431, 0904460	0901461	Digital Signal Processing	3	0901361
0904433	Heat Transfer (2)	3	0904430	0904432	Heat Transfer Lab.	1	Co. 0904433
0904571	Graduation Project I	1	Passing 120 credit hours		Specialization Elective	3	
0901435	Microcontroller	3	0901332		Specialization Elective	3	
	University Elective Course	3			University Elective Course	3	
					University Elective Course	3	
	Total	16			Total	18	