



Ministry of Higher Education & Scientific Research  
University of Mosul  
College of Engineering



## Mechanical Engineering Department

### **M.SC. CURRICULUM COURSES 2019/2020**

- M.Sc.- Applied Mechanics eng.
- M.Sc.-production & metallurgy eng.
- M.Sc.- thermal power eng.

## M. Sc. Courses Applied Mechanics

### Basic Topics

Course Number	Subject	No. of Hrs.				Units
		1 <sup>st</sup> term		2 <sup>nd</sup> term		
		Theo.	App.	Theo.	App.	
ME 501	Advanced Mathematics	2	-	-	-	2
ME 502	Experimental Design	-	-	2	-	2
ME 503	Computer Techniques			1	2	2
ME 541	Machine dynamics	2	-	-	-	2
ME 543	Elasticity and plasticity	-	-	3	-	3
ME 504	English language	1	1	1	1	2

## Selective Topics

Course Number	Subject	No. of Hrs.				Units
		1 <sup>st</sup> term		2 <sup>nd</sup> term		
		Theo.	App.	Theo.	App.	
ME 505	Automatic control	-	-	2	-	2
ME 542	Stress analysis	-	-	2	-	2
ME 544	Machine design	2	2			3
ME 551	Engineering Materials	2	-	-	-	2
ME 545	Composite Materials	-	-	2	-	2
ME 547	Fatigue engineering	2	-	-	-	2

- M. Sc. Thesis (ME 699) units = 10
- Selective topics to be on two courses and the total units is (26)
- Total units required with thesis = 36 unit

## M. Sc. Courses Thermal Power Engineering

### Basic Topics

Course Number	Subject	No. of Hrs.				Units
		1st term		2nd term		
		Theo .	App.	Theo .	App.	
ME 501	Advanced Mathematics	2	-	-	-	2
ME 502	Experimental Design	2	-	-	-	2
ME 503	Computer Techniques	-	-	1	2	2
ME 513	Advanced Fluid Mechanics	3	-	-	-	3
ME 516	Advance Heat and Mass Transfer	---	-	3	-	3
ME 504	English language	1	1	1	1	2

## Selective topics

Course Number	Subject	No. of Hrs.				Units
		1 <sup>st</sup> term		2 <sup>nd</sup> term		
		Theo.	App.	Theo.	App.	
ME 505	Automatic Control	-	-	2	-	2
ME 510	Internal combustion engine	2	--	--	--	2
ME 511	Power plant engineering	3	-	-	-	3
ME 512	Energy conservation	2	-	-	-	2
ME 518	Statistical Thermodynamics	--	--	2	--	2
ME 519	Entropy Generation	--	--	3	--	3
ME 524	Design of thermal system	--	--	3	--	3

- M.Sc. Thesis (ME 699) (10) unit
- Selective topics to be on two courses and total units is (26)
- Total units required with thesis = 36 unit

**M. Sc. Courses  
production and metallurgy Engineering**

**Basic Topics**

Course Number	Subject	No. of Hrs.				Credits
		1 <sup>st</sup> term		2 <sup>nd</sup> term		
		Theo.	App.	Theo.	App.	
ME 501	Advanced Mathematics	2	-	-	-	2
ME 502	Experimental Design	2	--	---	--	2
ME 503	Computer Techniques	--	--	1	2	2
ME 553	Applied metallurgy	2	--	--	--	2
ME 504	English language	1	1	1	1	2

## Selective Topics

Course Number	Subject	No. of Hrs.				Units
		1 <sup>st</sup> term		2 <sup>nd</sup> term		
		Theo.	App.	Theo.	App.	
ME 505	Automatic control	-	-	2	-	2
ME 520	Non Destructive Testing	2	--	--	--	2
ME 545	Composite Materials	---	---	2	--	2
ME 551	Engineering Materials	2	---	--	-	2
ME 552	Physical Metallurgy	3	-	-	-	3
ME 554	Work shop Technology	2	2	-	-	3
ME 555	Advanced Machining	--	--	2	2	3
ME 556	Industrial Engineering	-	-	2	-	2
ME 557	Metal forming	-	-	3	-	3

- M. Sc. Thesis (ME 699) units = 10
- Selective topics to be on two courses and total units is (26)
- Total units required with thesis = 36 unit

## M. Sc. Courses

### **ME 501 Advanced Mathematics ( 2 – 0 )**

Fourier Transforms

Bessel's Functions, Legendre Functions and Polynomials applied to the solution of Partial Differential Equations

Introductory to the calculus of variations, Galerkin and Ritz methods

### **ME 502 Experimental Design (2 – 0)**

The use for data collection and analysis

Basic statistical analysis

Parameters and estimators

Estimation and testing of hypothesis

Simple linear regression

Multiple linear regressions

Analysis of variance and ANOVA tables

Non-linear estimation

Model selection methods

Computer applications

### **ME 503 Computer Techniques (1 – 2)**

Computers and computational error

Roots of non-linear equations

Linear and non-linear systems of simultaneous equation

Numerical differentiation and truncation error

Numerical Integration single and multi-step methods

Solution of Ordinary Differential Equations

Finite differences solution of partial differential equations

### **ME 504 English Language (2 – 0)**

Grammar

The parts of speech

Features of scientific English

Features of scientific translation

Translating passages of the field

Scientific writing

### **ME 505 Automatic Control (2 – 0)**

**Open Loop and Closed Loop System, Frequency Response of Linear Control Systems, State – Space Function, Transfer Functions of Control Components.**

### **ME 510 Internal Combustion Engine (2 – 0)**

Basic Engine Types and Their Operation

Thermodynamic Principles of A – S Cycles

Combustion:

Combustion in S I Engines, Combustion in CI Engines

Performance Characteristics of IC Engines

Real Cycles Compared with Fuel – Air Cycles

Fuel Metering (Carburetor and fuel Injection)

Un supercharged and Supercharged Engines and their Performance

IC Engines Diesel Plant, Operation and Maintenance

Gas Turbine Engines and Plant



**ME 512 Energy Conservation (2 – 0)**

Introduction, Energy economics analysis, Electrical systems optimization, Waste heat recovery, Cogeneration, Thermal insulation, Thermal energy storage, Passive solar energy systems.

**ME 513 Fluid Mechanics (3 – 0)**

Fundamental of control volume concept  
Conservation equations of mass, momentum, and energy  
Bernoulli and Euler equations  
Internal and external laminar viscous boundary layer  
Internal and external turbulent viscous boundary layer  
Advanced Compressible fluid flow (selected topics)

**ME 516 Advanced Heat and Mass Transfer (3 – 0)**

Heat conduction concepts, thermal resistance, and the overall heat transfer coefficient  
The heat diffusion equation  
Analysis of heat conduction ( well-posed problem, fins design)  
Transient and multidimensional heat conduction  
Convection heat transfer (some introductory ideas of laminar and turbulent thermal boundary layer, Reynolds analogy)  
External and internal forced convection  
Natural convection  
Heat transfer in Boiling and other phase-change  
Thermal radiation heat transfer  
Heat exchanger design  
Mass Transfer

**ME 518 Statistical Thermodynamics (2 – 0)**

Boltz mann, Bose – Einstein and Fermi – Dirac Statistics  
Partition Function, Velocity Distribution  
Laws of Thermodynamics, Thermodynamic Properties  
Bose – Einstein Fermi – Dirac Statistics, Gas Mixtures  
Quantum Theory  
Translation and Rotation  
Vibration, Electronics States  
Monatomic Gases  
Monatomic Solids  
Diatomic and Polyatomic Gases  
Spectra  
Chemical Equilibrium  
Dissociation and Ionization

**ME 519 Entropy Generation (3 -0)**

Analysis of second law of thermodynamics –Definition of entropy change –Reversibility test –Methods of reversible heat transfer -Limitations imposed on second law of thermodynamics during change of state -Entropy transfer for cyclic systems- Entropy generation and exergy destruction – The Gouy-Stadola thermo –System communicating with more than one heat reservoir -Exergy analysis of steady state and non flow processes – Features of irreversible system .Entropy generation in fluid flow laminar and turbulent -Entropy generation in Heat TRANSFER –Conduction -Convection internal and external flows -Entropy generation in storage system .

**ME 520 Quality Control (NDT) (2 – 0)**

Types of defects and their origin (casting, welding and processing defects). Testing and non-destructive inspection, defects evaluation - Location, characterization & sizing using ultrasonic, radiography, penetrates, magnetic particles and eddy current techniques. Critical assessment of defects using the above methods. NDT techniques comparison.

**ME 524 Design of thermal systems (3 – 0)**

Introduction; Data analyses; Economics; Component simulation; System simulation system optimization; Different optimization methods

**ME 542 Stress Analysis (2 – 0)**

Theory of Photo elasticity techniques. Type of stress analysis measurements. Analysis and techniques electrical resistance strain Gauges, Semiconductor Gauges, Circuit Analysis of Various types of measurements. Motion measurements using force transducers. Rosette

**ME 544 Machine Design (2 – 2)**

Fracture mechanics and failures of machine resulting from static and variable loading. Computer aided design (CAD) of shaft for strength and rigidity. Optimization in design of a gear mesh (Helical and Bevel) for wear resistance. Case study of power transmission. Finite elements technique for a selected machine element using ANSYS software.

**ME 545 Composite materials (2-0)**

Introduction (Definitions, Characteristics and Properties, Classifications, and Fabrications Methods); Composite Response to Mechanical and Thermal loads or Stresses; Wettability and Interfacial Bonding; Stiffness and Strength of Unidirectional composites; Failure Criteria of Composites Materials; Estimation of Properties; Strengthening Mechanisms; Functionally Graded Composites (FGCs); Modeling of FGCs.

**ME 547 Fatigue engineering (2-0)**

Crack initiation and propagation, Linear elastic fracture mechanics, Fatigue factor, fatigue modes I, II, and III. Fatigue threshold under mode I, II, and III. Crack closure, Failure criteria for fracture, Strain energy release rate. The strain-energy density concept, Maximum normal crack tip stress and Maximum normal crack tip strain. Crack measuring techniques.

**ME 551 Engineering Materials (2-0)**

Metallic materials: Theory of alloying and alloy systems Ternary alloy systems, their equilibrium diagrams and industrial applications. Alloy steels. Heat-treatments of steels based on the T.T.T. curves. Failure analysis and prevention. Materials selection.

Non-metallic materials: Natural and synthetic rubbers, other elastomers. Plastics. Thermoplastics. Thermo setters. Ceramics. Carbon and graphite. Composite-materials including, concrete and wood. Processing, characteristics, and industrial applications of non-metallic materials.

**ME 552 Physical metallurgy (3-0)**

Metallographic of macrostructure and microstructure examination. Electron microscopes. X-ray diffraction. Equilibrium and non-equilibrium phase transformation. Heat treatable alloys of both ferrous & non-ferrous. Strengthening through non-equilibrium transformation (hardening & tempering and precipitation hardening). Work hardening phenomenon. Characteristics of micro corrosion.

**ME 553 Applied metallurgy (2-0)**

Extraction of ferrous & non ferrous metals and their related thermodynamic reactions. Smelting operation in steel making and in aluminum. Mechanics of equilibrium and non – equilibrium transformations. Transformation systems of stable and meta-stable reactions. Harden ability and heat – treatments of steels. Casting metallurgy. Metallurgical principles of welding and weld ability. Specifications of both metallic and non- metallic materials. Materials selection Selected topics.

**ME 554 Workshop Technology ( 2 – 2 )**

Numerical Control Machine and Robots Technology , Computer Technology for Manufacturing Systems ,Machine Tools and Processes ,Computer Aided Design Simulation and Design Methodology, Case Studies .

**ME 555 Advanced Machining Technology ( 2-2)**

**Turning:** Threading cutting, production turning machines.

**Milling :** vertical milling machines - Hole forming , Boring and shaping

- Horizontal milling machines - Machine setup and practice, Gear production , Helics and cams milling.

**CNC-MACHINES:** Vertical band machines. -Shaping , slotting , planing machines and broaching

**NON CONVENTIONAL MACHINES .**

Abrasive machines ; Electric Discharge machines (EDM)

Electrochemical machines. (EDM) ; Ultrasonic machines

Laser Beam machines ;Plasm machines

**ME 556 Industrial Engineering ( 3 – 0 )**

Production Analysis, Planning and Control, Layout of Facilities, Quality and Reliability, Work and Motion Study, Ergonomics, Financial Analysis, Human Aspects ,Robot Structures ,Control of Industrial Robots, Case studies.

**ME 557 Metal Forming ( 3 – 0 )**

Materials Processing, Die – Design ,Different Types of Forging Processes ,High Speed Metal Forming ,Die – Wear ,Lubrication in Metal Forming ,Economic Decisions in Metal Forming.