

**Ministry of Higher Education & Scientific Research**

**University of Baghdad – College of Engineering**

**Mechanical Engineering Department**



**MECHANICAL ENGINEERING  
POSTGRADUATE PROGRAMS HANDBOOK**

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## Preface

The present handbook was written to provide a simple and clear guide for postgraduate programs offered by the Mechanical Engineering Department / College of Engineering – University of Baghdad. The work is based on a long experience for the author lasted for more than twenty years of work in the field of postgraduate studies, supervising 38 Thesis and 17 Dissertations, and the membership of the examining committees and evaluation of more than (260) M.Sc. Theses and Ph.D. Dissertations.

The handbook represents the first attempt along the history of the department and college written with a broad scope and details. It was written to be consistent with the prevailing laws and regulations of Baghdad University related to the postgraduate programs.

We would like here to express our thanks and appreciation to all who expressed their opinions, notes, and remarks which enrich the work too much. Special thanks and appreciation are to Dr. Luma F. Ali and Dr. Mohammed A. Nema, who helped too much in editing this handbook.

It should be mentioned here that the work will remain continuous and adjustable for any updating and modifications or development in the future. We will be very grateful to all who will provide us with any opinion, note, comment, or suggestion to improve the work. God bless all good efforts that serve humanity.....

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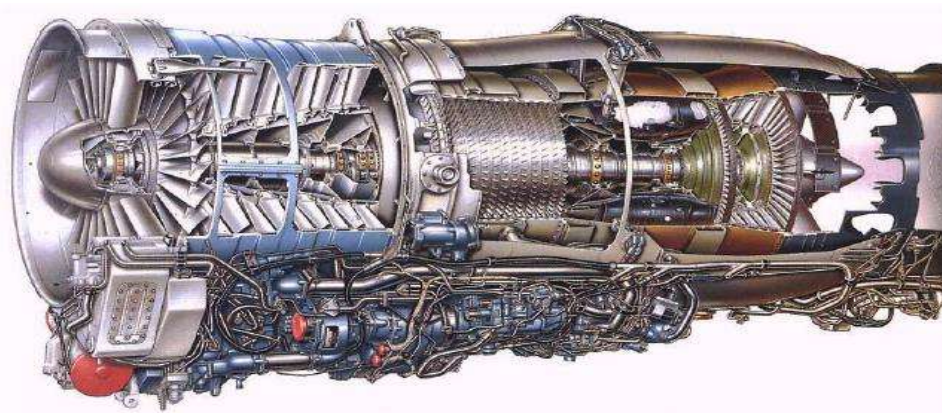
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## 1. Introduction

Mechanical engineering is among the most diverse and demanding of the engineering disciplines. Applying their talents to manned exploration of space or the sea, transportation, energy, the environment, to the development of machinery or bioengineering, mechanical engineers make significant contributions to the quality of human life. A graduate degree in mechanical engineering is an entree to both technically challenging and personally rewarding opportunities in academia, industry, and government. The advancing technology of our nation makes the continuation of study toward an advanced degree advisable for motivated students.

### 1.1 Historical Background

The Department of Mechanical Engineering at the University of Baghdad is the oldest Mechanical Engineering Department among all the Iraqi Universities and Institutes. It was established in 1950. The duration of study was four years, after which the graduate obtains a bachelor degree in Mechanical Engineering. A five years study system was introduced in 1971 for the first time, but was returned to a four years system the following year. Specialization used to begin in the fourth year of study in four specialties of mechanical engineering, these are; (Power, Design, Manufacturing, and Textile). The specialty of (Textile Engineering) was established in the department in the academic year (1976–1977), after which, (Agricultural Machinery Engineering) specialty was established, and the (Power, Design, and Manufacturing) specialties were merged to the specialty (General Mechanics) to form with the (Agricultural Machinery Engineering) and (Textile Engineering) the three main specialties of the department.

The study in the department continued in this manner until after the mid eighties where the College of Engineering was relocated from its former building at Bab Al-Muathem campus to its current buildings at Aljaderiya campus. After this relocation, the two specialties of (Agricultural Machinery Engineering) and (Textile Engineering) were separated from the Mechanical Engineering Department to become the core for the formation of the Mechanical Engineering

Department at the College of Engineering / Al-Mustanseriya University, which used the College of Engineering's old buildings. In the academic year (1990-1991), the specialty of (Aeronautical Engineering) was established as a new specialty in addition to the (General Mechanics) specialty. The specialization starts from the third year.

The postgraduate programs in the department started at the academic year (1971-1972) to obtain the M.Sc. degree in Mechanical Engineering in two specialties; (Power) and (Mechanical Design). In the academic year (1976-1977) the Higher Diploma degree program started, and stopped after the mid eighties. The Ph.D. degree program started at the academic year (1982-1983). At the present, the M.Sc. and Ph.D. programs cover all the four specialties of the department which will be mentioned in the next article.

## 1.2 The Awarded Degrees

At the present, the department offers engineering programs leading to the degree of Bachelor of Science (B.Sc.), Master of Science (M.Sc.) and Doctor of Philosophy (Ph.D.) in Mechanical Engineering. The B.Sc. degree includes two specialties; the "*General Mechanics*" and the "*Aeronautical Engineering*", whereas the M.Sc. and Ph.D. degrees cover four areas of research; "*Thermo-Fluids*", "*Applied Mechanics*", "*Manufacturing of Engineering Materials*" and "*Industrial Engineering*". These specialties offered to the postgraduate students are aimed at creating a strong theoretical background required for research, teaching, and engineering consultants, it also aims at bringing the gap between academia and industrial needs.

Students pursuing the (M.Sc.) degree must complete a minimum of (26 to 28) units of course work and (8) units of thesis work. The minimum course work requirements for the (Ph.D.) degree are (26) units beyond the master's degree. Potential Ph.D. candidates must pass the comprehensive examination within two years after entry into the program. The final (Ph.D.) examination consists of an oral defense of the research dissertation.

### 1.3 Admission Policy

The admission to graduate programs of Mechanical Engineering at the Mech. Engr. Dept. / University of Baghdad is made through the central admission system of the college and university. The applicant must satisfy the following requirements:

1. For M.Sc. programs, the applicant should have an average not less than (65 %), or from the top (25 %) of the alumni.
2. For Ph.D. programs, the applicant should have an average not less than (70 %).
3. The age of the applicant should not exceed (45 years) for M.Sc. programs and (50 years) for Ph.D. programs.
4. If the applicant is an employee in the state offices, he/she must have a minimum of (2 years) employment.
5. The applicant must pass an interview made by the department to check his/her psychological, physical, and mental safety.
6. The admission is allowed for the alumni of the private colleges and universities authorized by the Ministry of Higher Education and Scientific Research.
7. The competition between the applicants is made through the (*competition average*), which is based on the following criteria;
  - a. Graduation average (weight = 60 %).
  - b. Entrance exam (weight = 20 %).
  - c. English language test (weight = 5 %).  $\text{Weight Degree} = 5 * (\text{Degree of Exam} / \text{Max. Mark of the Exam})$ .
  - d. Computer efficiency test (weight = 5 %).  $\text{Weight Degree} = 5 * (\text{Degree of Exam} / \text{Max. Mark of the Exam})$ .
  - e. Graduation ranking (weight = 5 %, for M.Sc. programs only).  $\text{Weight Degree} = 5 * \{1 - [(\text{Student's Ranking}-1)/\text{Number of Alumni}]\}$ .
  - f. Innovation activities (weight = 5 % for M.Sc. programs, and 10 % for Ph.D. programs). Weight degree is calculated according to central criteria from the ministry and university.



8. The admission period is two months starts at July every year.
9. The applicant must submit the required documents within the admission period. These documents include (graduation records with average and ranking, agreement of the office for the employees, application forms, ID card and official documents, and colored photos).

Admission to (ME) programs is highly competitive. As explained above, applicants are granted admission in accordance with an overall evaluation on the basis of their rating record, but only to the extent permitted by the maximum number of new admission plan adapted for that academic year.

### 1.4 Number of Postgraduate Students

Table (1) shows statistical figures for the number of postgraduate students of the department at the present time (April / 2014).

**Table (1): Number of Postgraduate Students of the MED**

Specialty	Stage of Study	Program		
		M.Sc.	Ph.D.	M.Sc. + Ph.D.
<b>Thermo-Fluids</b>	Academic Year (courses)	7	1	8
	Research	14	17	31
	Comprehensive	/	/	/
	Total	21	18	39
<b>Applied Mechanics</b>	Academic Year (courses)	9	3	12
	Research	12	5	17
	Comprehensive	/	/	/
	Total	21	8	29
<b>Manufacturing &amp; Industrial Engr.</b>	Academic Year (courses)	7	/	7
	Research	12	1	13
	Comprehensive	/	/	/
	Total	19	1	20
<b>All Specialties</b>	Academic Year (courses)	23	4	27
	Research	38	23	61
	Comprehensive	/	/	/
	Total	61	27	88



## **2. Research Areas and Facilities**

### **2.1 Research Areas**

The Mechanical Engineering Department faculty is involved primarily in four research areas, these are;

- 1- Thermo – Fluids Engineering
- 2- Applied Mechanics
- 3- Manufacturing of Engineering Materials
- 4- Industrial Engineering

The thermo–Fluids science group deals with a broad spectrum of activities involving flow and heat transfer in a variety of practical problems including Heat Exchangers, Fluid Dynamics, Two-Phase Flow, Forced and Free Convection Heat Transfer, Aerodynamics of Flying Bodies, Air-Conditioning and Refrigeration Systems, Turbulent Flow and Heat Transfer in Internal and External Systems, CFD Applications, Nanofluids, Porous Media, New & Renewable Energies, Jet Engines, Combustion.. etc.

Faculty in the applied mechanics group deal with broad spectrum of lines of research such as; Elasticity, Plasticity, Automatic Control, Structural Dynamics, Robotics, Stress Analysis, Gears, Vibration, Biomedical Engineering, Composite Materials, Crack Detection, Smart Materials, Tribology.... etc.

The research efforts of the manufacturing of engineering materials group are concerned with various processes, such as Casting, Welding, Forming, Forging, Extrusion, Metallurgy... etc.

The industrial engineering group deals with, Production Planning, Quality Control, Reliability, Expert Systems, Virtual Management, Agent Base Management, C/A Maintenance and Management, Supply Chain Management, Multi-Stage Facility Location Problems.... etc.

### **2.2 Facilities**

The faculty and postgraduate students have sufficiently adequate (with minimum requirements) facilities available for conducting successful programs.

The facilities include several laboratories, workshop, department library, college and university libraries.

The Mechanical Engineering Department contains many laboratories and workshops which include many devices and equipment used to conduct the experimental tests by undergraduate students and it is helpful to conduct the engineering projects by the forth class students, in addition to the ability of using many of them to achieve different tests and other works to the government establishments, private sector, postgraduate students and researchers generally. Table (2) summarizes the list of available labs and their sizes.

**Table (2): Laboratories of the MED**

No.	Lab Name	Location (Building No.)	Subjects Served by Lab.	Lab Capacity number of students/session	Lab. space (m <sup>2</sup> )	
1	Heat Lab.	Heat Transfer	1	ME303, ME407	8 - 10	396
2		Thermodynamics	1	ME203,ME407	8 - 10	
3		Power Plants	1	ME404, ME407	8 - 10	
4		I.C. Engines	1	ME404, ME407	8 - 10	
5	Dynamic Lab.	Control	1	ME402, ME407	8 - 10	140
6		Vibration	1	ME305, ME407	8 - 10	
7		Theory of Machines	1	ME204, ME305 ME407	8 - 10	
8	Strength of Material	1	ME204, ME304 ME310, ME407	8 - 10	270	
9	Computers	1	ME103, ME106 ME207, ME301 ME401, ME407	20 - 30	148	
10	Air-Conditioning	1	ME403, ME407	8 - 10	216	
11	Measurements	1	ME104, ME306 ME311, ME407	8 - 10	102	
12	Fluid Mechanics	2	ME202, ME302 ME309, ME409 ME407	8 - 10	344	
13	Wind Tunnel	2	ME410, ME407	/	216	
14	Metallurgy	4	ME205, ME406 ME407	8 - 10	324	
15	Electrical Engineering	4	ME105, ME307	8 - 10	32	
16	Workshop	4	ME104, ME306 ME311, ME407	40 - 50	2300	

The library of the department was established in 2009 and offers services to the students, faculty members, engineering and technical staff

of the department. Besides, the library is also accessible to students and researchers from other departments in the college and from other colleges inside and outside the university, and also for researchers from various state offices and ministries. In brief, the library has the following facilities:

- Area of the library ( 48 m<sup>2</sup> )
- 950 Books
- 166 Periodical
- 517 P.G. Theses and Dissertations
- 859 B.Sc. Graduation Projects
- 60 B.Sc. Students' Seminars
- 330 CDs
- 2 Internet Access Terminals
- About 50 Title and 7000 books in the free bookshop as a textbooks for undergraduate students

The Library of Engineering College is one of the oldest scientific libraries in the University of Baghdad. It was established in 1941, and then developed well in the later years to become one of the mother libraries in engineering. Lastly, the library finished the documentation of all books, periodicals, theses and dissertations in a complete data base. The library continuously organizes and / or participates in book fairs. The following is a brief of the library facilities and activities:

- Area of the library ( 3000 m<sup>2</sup> )
- 76185 Books
- 1450 Periodicals
- 3 Reading Halls
- 1000 Reading Seats
- 1 m<sup>2</sup> / Person for Reading
- 6 Computers for Office Work

- 750 CDs
- 125 Scientific Film
- 5 Internet Service Terminals
- 35 Hours / Week Access
- 135 Books / Day Circulating

The Central Library of the Baghdad University is one of the main oldest libraries in Iraq. It was established in 1959. The library now has two buildings, one in the Al-Jadiriya Campus and the other in the Bab Al-Muaatham Campus. The following is a brief of the library facilities and activities:

- Area of the library ( 20549 m<sup>2</sup> )
- 319142 Books
- 20784 Periodicals
- 4 Reading Halls, ( 549 m<sup>2</sup> ) each
- 210 Reading Seats
- 3 m<sup>2</sup> / Person for Reading
- 62 Computers for Office Work
- 544 CDs & 35 Flash Ram
- 791 Scientific Film
- 35 Internet Service Terminals
- 35 Hours / Week Access
- 356 Books / Day Circulating
- Continuous Organization of Book Fairs
- Continuous Learning Courses
- Installing WIN-ISIS Electronic Systems for Offices Work

The network access facilities are provided by the Computer Center of Baghdad University in the form of a Wireless LAN network available in all university buildings. Both faculty and students can access the network.

### **3. M.Sc. Degree Programs**

#### **3.1 Degree Requirements**

The minimum credit hour requirements for Master's degree in the Mechanical Engineering Department are (34-36) semester hours beyond the baccalaureate, of which eight semester hours are in a thesis. Additional hours may be required depending on the student's background, objectives of the degree program, and the demands of the discipline.

All coursework satisfying degree requirements must be in graduate courses numbered 500 and above (see article 6). All work for Master's degree must be completed during two years (minimum), could be extended to three years (maximum). All coursework for master's degree must be completed with an overall average not less than (70) with minimum mark (60) for each course.

The department expects the students to meet fully the rigorous demands of its program. For many students, this will mean weekly time investment averaging at least four hours for each semester hour of graduate registration. This figure is derived from experience which shows that each hour of class work will generate three hours of homework. Each student should bear this in mind in working out the schedule of studies.

The program in the major field usually includes basic curriculum core courses, plus electives in the particular area of interest to the student. The courses are drawn from the various offerings of the department faculty, as well as other external lecturers from other universities.

Master's degree required a thesis in partial fulfillment of the degree requirements. The student must pass an oral examination in the thesis, administrated by an examining committee recommended by the department chairman and graduate studies committee. The oral examination involves, largely, a defense of the thesis, although questions may be asked in related subjects. At least, three members must participate in all examinations, one of them is chosen from other universities or from industry.

## 3.2 M.Sc. Course Work

### I. Thermo-Fluids

	Code	Subject	Hours	Units
1 <sup>st</sup> Semester	ME500	Advanced Mathematics	3	3
	ME531	Advanced Heat Transfer / I – Conduction and Radiation	3	3
	ME530	Advanced Thermodynamics	3	3
	ME510	Advanced Fluid Mechanics	3	3
	ME508	English Language / I	1	1
	Total			13
2 <sup>nd</sup> Semester	ME501	Advanced Numerical Analysis	3	3
	ME532	Advanced Heat Transfer / II – Convection and Mass Transfer	3	3
	-	Elective (1)	3	3
	-	Elective (2)	3	3
	ME509	English Language / II	1	1
	Total			13
3 <sup>rd</sup> & 4 <sup>th</sup> Semester	Thesis Work			8
Total				34

- Elective Courses for M.Sc. / Thermo – Fluids

Code	Subject
ME511	Computational Fluid Dynamic
ME513	Advanced Aerodynamics
ME514	Advanced Gas Dynamics
ME515	Advanced Turbo machinery
ME516	Two-Phase Flow
ME525	Hydraulic Systems
ME533	Advanced Air-conditioning
ME534	Advanced Refrigeration
ME535	Two-Phase Heat Transfer
ME536	Nanofluid Heat Transfer
ME537	Solar Energy
ME539	Advanced Combustion
ME543	Measurements System and Dynamic

## II. Applied Mechanics

	Code	Subject	Hours	Units
1 <sup>st</sup> Semester	ME500	Advanced Mathematics	3	3
	ME551	Advanced Control	3	3
	ME553	Elasticity	3	3
	ME552	Experimental Stress Analysis	3	3
	ME508	English Language / I	1	1
	Total			13
2 <sup>nd</sup> Semester	ME501	Advanced Numerical Analysis	3	3
	ME550	Advanced Vibrations	3	3
	ME554	Plasticity	3	3
	-	Elective	3	3
	ME509	English Language / II	1	1
	Total			13
3 <sup>rd</sup> & 4 <sup>th</sup> Semester	Thesis Work			8
Total				34

### • Elective Courses for M.Sc. / Applied Mechanics

Code	Subject
ME555	Tribology
ME558	Fracture Mechanics
ME561	Structures Analysis
ME562	Mechanical Behavior of Materials
ME568	Artificial Intelligence
ME569	Composite Materials





### III. Manufacturing of Engineering Materials & Industrial Engineering

	Code	Subject	Hours	Units
1 <sup>st</sup> Semester	ME580	Advanced Engineering Materials / I	3	3
	ME570	Advanced Manufacturing / I	3	3
	ME501	Advanced Numerical Analysis	3	3
	ME590	Operation Research / I	2	2
	ME592	Advanced Statistics	2	2
	ME508	English Language / I	1	1
	Total			14
2 <sup>nd</sup> Semester	ME581	Advanced Engineering Materials / II	3	3
	ME571	Advanced Manufacturing / II	2	2
	-	Elective (1)	3	3
	-	Elective (2)	3	3
	-	Elective (3)	2	2
	ME509	English Language / II	1	1
	Total			14
3 <sup>rd</sup> & 4 <sup>th</sup> Semester	Thesis Work			8
Total				36

- Elective Courses for M.Sc. / Manufacturing of Engineering Materials & Industrial Engineering

Code	Subject
ME554	Plasticity
ME572	Machining Processes
ME573	Welding
ME591	Operation Research / II
ME593	Quality Control
ME594	Production Planning
ME595	CAD / CAM
ME596	Maintenance Planning and Control

## **4. Ph.D. Degree Programs**

### **4.1 Introduction**

The objective of this degree is to provide students with adequate preparation to meet the doctoral standards in an applied science or engineering practice, in addition to a strong theoretical background. Applied sciences as a focus for the doctoral degree refers to the study of advanced theory and its application to practical problems in order to test and verify performance and limitations. A doctorate with focus on applied science requires a high level of expertise in the theoretical aspects of the relevant scientific principles and experience with the details of the implementation of this theory on realistic problems. Engineering practice as a focus for a doctoral standard is the study of the different aspects which play a role in the transfer of technology from its inception in research to the intended engineering environment. This requires a high level of expertise in:

1. Theoretical aspects of the relevant scientific principles.
2. Solving the problems and understanding the details of the transfer and application of the technology
3. Economic issues

The Ph.D. degree is expected to make a significant advance to scientific knowledge, or to make a contribution to the science by studying its implementation and participating in the transformation of knowledge into technology.

### **4.2 Degree Requirements**

The Ph.D. program of the Mechanical Engineering Department is usually designed to fit the candidate research activity. The general requirements for the Ph.D. degree include the following components;

1. The student must have a M.Sc. degree.
2. A minimum academic coursework of (26) semester credit hours, including a major as well as a minor area, which should be in an area providing breadth as well as support to the major field of investigation.

3. A comprehensive examination taken after the student has completed the course work. The requirements for this examination schedules and areas of examination and the instruction will be described in a next article.
4. After passing the comprehensive examination, the student must select the dissertation subject and starts the dissertation work. The dissertation must make a real contribution to the engineering or the applied science discipline and it is expected to be a mature and competent piece of writing. The work which it reports may be basic scientific research, engineering research, or creative design.
5. The student must pass an oral examination in the dissertation administrated by an examining committee comprised of not less than five members (two of them are from other universities or from industry).

All requirements for the Ph.D. degree must be satisfied within (3to 4) years after the date of registration.

### 4.3 Ph.D. Course Work

#### I. Thermo – Fluids

	Code	Subject	Hours	Units
<b>1<sup>st</sup> Semester</b>	ME601	Advanced Mathematics / FEM	3	3
	/	Major Elective Course (1)	3	3
	/	Major Elective Course (2)	3	3
	/	Minor Elective Course	3	3
	ME608	English Language / I	1	1
	<b>Total</b>			<b>13</b>
<b>2<sup>nd</sup> Semester</b>	ME602	Advanced Mathematics / BEM	3	3
	/	Major Elective Course (1)	3	3
	/	Major Elective Course (2)	3	3
	/	Minor Elective Course	3	3
	ME609	English Language / II	1	1
	<b>Total</b>			<b>13</b>
<b>3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> &amp; 6<sup>th</sup> Semester</b>	<b>Dissertation Work</b>			<b>38</b>
<b>Total</b>				<b>64</b>

- **Major Elective Courses for Ph.D. / Thermo - Fluids**

Code	Subject
ME610	Turbulence
ME613	Fluid Transient
ME630	Selected Topics in Heat Transfer / I
ME631	Selected Topics in Heat Transfer / II
ME632	Cryogenics
ME633	New and Renewable Energies
ME634	Heat Transfer in Porous Media

- **Minor Elective Courses for Ph.D. / Thermo - Fluids**

Code	Subject
ME550	Advanced Vibrations
ME551	Advanced Control
ME570	Advanced Manufacturing / I
ME580	Advanced Engineering Materials / I
ME581	Advanced Engineering Materials / II
ME697	Optimization in Engineering Design

## II. Applied Mechanics

	Code	Subject	Hours	Units
1 <sup>st</sup> Semester	ME601	Advanced Mathematics / FEM	3	3
	/	Major Elective Course (1)	3	3
	/	Major Elective Course (2)	3	3
	/	Minor Elective Course	3	3
	ME608	English Language / I	1	1
	Total			13
2 <sup>nd</sup> Semester	ME602	Advanced Mathematics / BEM	3	3
	/	Major Elective Course (1)	3	3
	/	Major Elective Course (2)	3	3
	/	Minor Elective Course	3	3
	ME609	English Language / II	1	1
	Total			13
3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> & 6 <sup>th</sup> Semester	Dissertation Work			38
Total				64

- **Major Elective Courses for Ph.D. / Applied Mechanics**

Code	Subject
ME650	Structural Dynamic
ME651	Energy Methods in Applied Mechanics
ME652	Plates and Shells
ME653	Advanced Mechanical Behaviour of Materials
ME654	Approximate Methods in Mechanical Engineering
ME655	Analysis and Design of Control Systems
ME656	Fracture , Fatigue and Creep
ME657	Advanced Composite Materials
ME662	Automation and Robotics
ME663	Advanced Fracture Mechanics

- **Minor Elective Courses for Ph.D. / Applied Mechanics**

Code	Subject
ME510	Advanced Fluid Mechanics
ME531	Advanced Heat Transfer / I – Conduction and Radiation
ME532	Advanced Heat Transfer / II – Convection and Mass Transfer
ME570	Advanced Manufacturing / I
ME580	Advanced Engineering Materials / I
ME581	Advanced Engineering Materials / II
ME697	Optimization in Engineering Design



### III. Manufacturing of Engineering Materials

	Code	Subject	Hours	Units
1 <sup>st</sup> Semester	ME601	Advanced Mathematics / FEM	3	3
	/	Major Elective Course (1)	3	3
	/	Major Elective Course (2)	3	3
	/	Minor Elective Course	3	3
	ME608	English Language / I	1	1
	Total		13	13
	2 <sup>nd</sup> Semester	ME602	Advanced Mathematics / BEM	3
/		Major Elective Course (1)	3	3
/		Major Elective Course (2)	3	3
/		Minor Elective Course	3	3
ME609		English Language / II	1	1
Total		13	13	
3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> & 6 <sup>th</sup> Semester	Dissertation Work			38
Total				64

- Major Elective Courses for Ph.D. / Manufacturing of Engineering Materials

Code	Subject
ME670	Advanced Casting Technology
ME671	Automatic Control of Manufacturing Processes
ME672	Advanced Welding Technology
ME680	High Temperature Materials
ME681	Advanced Composite Materials
ME696	Computer Integrated Manufacturing CIM

- Minor Elective Courses for Ph.D. / Manufacturing of Engineering Materials

Code	Subject
ME510	Advanced Fluid Mechanics
ME531	Advanced Heat Transfer / I – Conduction and Radiation
ME532	Advanced Heat Transfer / II – Convection and Mass Transfer
ME551	Advanced Control
ME697	Optimization in Engineering Design

#### IV. Industrial Engineering

	Code	Subject	Hours	Units	
1 <sup>st</sup> Semester	ME601	Advanced Mathematics / FEM	3	3	
	/	Major Elective Course (1)	3	3	
	/	Major Elective Course (2)	3	3	
	/	Minor Elective Course	3	3	
	ME608	English Language / I	1	1	
	Total			13	13
	2 <sup>nd</sup> Semester	ME602	Advanced Mathematics / BEM	3	3
/		Major Elective Course (1)	3	3	
/		Major Elective Course (2)	3	3	
/		Minor Elective Course	3	3	
ME609		English Language / II	1	1	
Total			13	13	
3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> & 6 <sup>th</sup> Semester	Dissertation Work			38	
Total				64	

- Major Elective Courses for Ph.D. / Industrial Engineering

Code	Subject
ME692	Groups Technology
ME693	Expert Systems
ME694	Advanced Industrial Quality Control
ME697	Optimization in Engineering Design
ME699	Reliability

- Minor Elective Courses for Ph.D. / Industrial Engineering

Code	Subject
ME510	Advanced Fluid Mechanics
ME551	Advanced Control
ME570	Advanced Manufacturing / I
ME580	Advanced Engineering Materials / I
ME581	Advanced Engineering Materials / II
ME696	Computer Integrated Manufacturing CIM



## 5. Ph.D. Comprehensive Examination System

### 5.1 Introduction

This examination is comprehensive in scope, covering the student's entire academic career, and includes the major and minor areas planned for the Ph.D. degree. It is conducted by an examining committee from faculty members drawn from the major and minor areas of concentration and is both written and oral. Not less than four faculty members are present for the oral examination. Successful performance on the examination results in a recommendation that the student be admitted to candidacy for the Ph.D. degree. If the student fails the examination, a second chance of re-examination is recommended by the committee within 4 – 6 months period.

### 5.2 Date of Examination

The examination is made three times in the year. The first one is in the first week of October, the second is in the first week of February, and the third one is in the first week of June, the student should make the exam four months (maximum) after he passed the course work.

### 5.3. Examination Days and Marks

a. Examination Time: Four hours daily

b. Examination Days and Marks

1 <sup>st</sup> day: Major Subjects, Closed Book	25%
2 <sup>nd</sup> day: Major Subjects, Open Book	25%
3 <sup>rd</sup> day: Minor Subject and Mathematics	20%
4 <sup>th</sup> day: Day Off	
5 <sup>th</sup> day: Oral Exam	30%
<hr/>	
Total	100%

c. Success Mark:

The overall average of the four days of the exam must be not less than (70%), otherwise, the student will be considered fail in the exam, and he has the right of re-examination for only one time next other 4 - 6 months.

## 5.4. Subjects of Examination

The major and minor subjects and the mathematics of the exam are dealt with as a knowledge field covering all what the department student studies in the under-graduate and graduate programs, and as follows;

### 5.4.1 Thermo-Fluids Engineering

Major Subjects: The student must choose *two* of the following three knowledge fields:

- 1- Fluid Mechanics: Includes; Fluid Mechanics/I & II (ME202 & ME302) courses of the undergraduate program, and Advanced Fluid Mechanics (ME510) course of the M.Sc. program.
- 2- Heat Transfer: Includes; Heat Transfer (ME303) course of the undergraduate program, and Advanced Heat Transfer/I & II (ME531 & ME532) courses of the M.Sc. program.
- 3- Thermal Science: Includes; Thermodynamics (ME203) course of the undergraduate program, Advanced Thermodynamics (ME530) course of the M.Sc. program, Power Engineering (ME404) and Air Conditioning and Refrigeration (ME403) courses of the undergraduate program, and related courses of the M.Sc. and Ph.D. programs.

Minor Subject: The student can choose one of the following M.Sc. courses; Advanced Control (ME551), Advanced Vibrations (ME550), Advanced Engineering Materials/I & II (ME580 & ME581), Advanced Manufacturing/I (ME570).

**Mathematics:** Includes all the Mathematics courses of the undergraduate program (ME101, ME201, ME301), and courses of the M.Sc. and Ph.D. programs (ME500, ME501, ME601, ME602).

### 5.4.2 Applied Mechanics

**Major Subject:** The student must choose *two* of the following three knowledge fields;

- 1- **Stress Analysis:** Includes; Engineering Mechanics (ME102), Mechanics of Materials and Machines (ME204), Strength of Materials (ME304), and Design of Machine Elements (ME401) courses of the undergraduate program, and Elasticity (ME553), Plasticity (ME554), and Experimental Stress Analysis (ME552) courses of the M.Sc. program.
- 2- **Vibrations and Control:** Includes; Mechanics of Machines and Vibrations (ME305) and Control and Measurements (ME402) courses of the undergraduate program, and Advanced Control (ME551), and Advanced Vibrations (ME550) courses of the M.Sc. program.
- 3- **Dynamics:** Includes; Engineering Mechanics (ME102), Mechanics of Materials and Machines (ME204) courses of the undergraduate program, and Structural Dynamic (ME650), Advanced Fracture Mechanics (ME663), and related courses of the M.Sc. and Ph.D. programs.

**Minor Subject:** The student can choose one of the following M.Sc. courses; Advanced Engineering Materials/I & II (ME580 & ME581), Advanced Manufacturing/I (ME570), Advanced Heat Transfer/I & II (ME531 & ME532), Advanced Fluid Mechanics (ME510), and Optimization in Engineering Design (ME697).

**Mathematics:** Includes all the Mathematics courses of the undergraduate program (ME101, ME201, ME301), and courses of the M.Sc. and Ph.D. programs (ME500, ME501, ME601, ME602).

### 5.4.3 Manufacturing of Engineering Materials

Major subject: The student must choose the following two knowledge fields:

- 1- Manufacturing Processes: Includes; Principles of Production Engineering (ME104) and Principles of Manufacturing Processes (ME306) courses of the undergraduate program, and Advanced Manufacturing/I & II (ME570 & ME571), courses of the M.Sc. program.
- 2- Engineering Material: Includes; Engineering of Metallurgy (ME205) and Engineering Materials (ME406) courses of the undergraduate program, and Advanced Engineering Materials/I & II (ME580 & ME581) courses of the M.Sc. program.

Minor Subject: The student can choose one of the following M.Sc. courses; Advanced Control (ME551), Advanced Vibration (ME550), Advanced Heat Transfer/I & II (ME531 & ME532), Advanced Fluid Mechanics (ME510), Operation Research (ME590), and Production Planning (ME594).

Mathematics: Includes all the Mathematics courses of the undergraduate program (ME101, ME201, ME301), and courses of the M.Sc. and Ph.D. programs (ME500, ME501, ME601, ME602).

### 5.4.4 Industrial Engineering

Major Subject: The student must choose *two* of the following three fields of knowledge;

- 1- Production Planning: Includes; Industrial Engineering (ME405) course of the undergraduate program, and Production Planning (ME594), Quality Control (ME593), and Groups Technology (ME692) courses of the M.Sc. and Ph.D. programs.
- 2- Artificial Intelligence: Includes; Expert Systems (ME693), Advanced Artificial Intelligence (ME664), Automation and Robotics (ME662), and CAD/CAM (ME595) courses of the M.Sc. and Ph.D. programs.

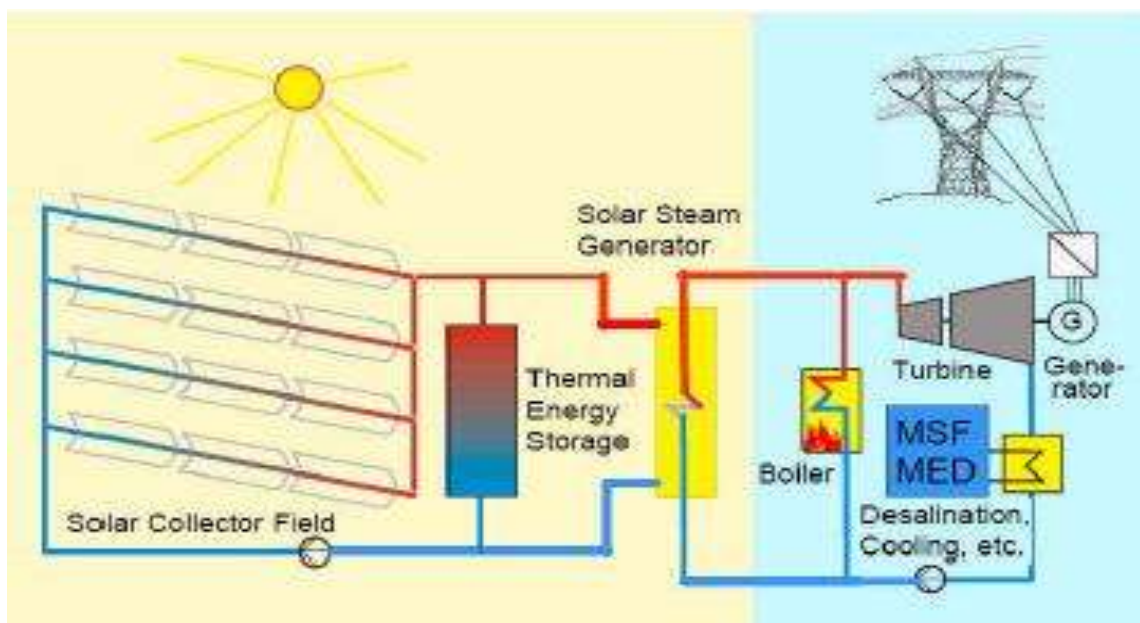
3- Optimization: Includes; Operation Research (ME590), Statistics (ME592), and Optimization in Engineering Design (ME697) courses of the M.Sc. and Ph.D. programs.

Minor Subject: Minor Subject: The student can choose one of the following M.Sc. courses; Advanced Control (ME551), Advanced Vibration (ME550), Advanced Manufacturing/I & II (ME570 & ME571), and Advanced Engineering Materials/I & II (ME580 & ME581).

Mathematics: Includes all the Mathematics courses of the undergraduate program (ME101, ME201, ME301), and courses of the M.Sc. and Ph.D. programs (ME500, ME501, ME601, ME602).

## 5.5 Registration

The student must submit a signed registration request to the department at least one month before the exam. The request should include the major and minor fields chosen by the student.



## 6. Courses of MED

### 6.1 Introduction

All courses offered in the Mechanical Engineering Department are identified by the two letter prefix code (ME), designating the Mechanical Engineering, followed by a three digit number. The first digit specifies the approximate level of the course as follows:

6	Ph.D. Course	}	Graduate Courses
5	M.Sc. Course		
4	4 <sup>th</sup> Year Course	}	Undergraduate Courses
3	3 <sup>rd</sup> Year Course		
2	2 <sup>nd</sup> Year Course		
1	1 <sup>st</sup> Year Course		

The last two digits specify the course numbers. Thus: (ME520) denotes a course offered at the M.Sc. level, having the course number (20).

### 6.2 Classification of Courses

The M.Sc. and Ph.D. courses are numbered according to the following classification with respect to the field of specialization;

<u>Course Number</u>	<u>Field of Specialization</u>
00-09	Mathematics and Language
10-29	Fluid Mechanics
30-49	Thermal Sciences
50-69	Applied Mechanics
70-79	Manufacturing Processes
80-89	Engineering Materials
90-99	Industrial Engineering

In the next sections, a bulletin description of all courses related to the postgraduate programs will be given.

## 6.3 Description of M.Sc. Courses

### 6.3.1 Mathematics and Language

#### **ME500 Advanced Mathematics (3 hrs.)**

Vectors, Tensors, Matrices, Laplace Transformation, Function of Complex Variables, Conformal Mapping, Contour Integration, Bessel Equation and Functions, Power Series, Legendre Polynomials, Fourier Integrals, Partial Differential Equations.

Prerequisite Courses: ME101, ME201, ME301.

#### **ME501 Advanced Numerical Analysis (3 hrs.)**

Curve Fitting, Roots of Equations, Numerical Integration, Numerical Differentiation, Solving Sets of Equations, Numerical Solution of Partial Differential Equations.

Prerequisite Courses: ME101, ME201, ME301.

#### **ME508 English Language / I (1 hr.)**

Parts of Speech, Punctuation, Kinds of Sentences, Pronouns, Verb Tenses, Numbers, Phonetics, Agreement of Subject and verb, Definite and Indefinite Articles, Spelling, How the Suffix "S" is pronounced, Preposition of Time, Model Verbs, Phrasal Verbs.

Prerequisite Courses: None

#### **ME509 English Language / II (1 hr.)**

Technical Reporting: Fundamental Principles, General Procedure, Technical Description, Reports, Theses and Dissertations, Technical Papers and Articles, Oral Reports and Speaking in Public, Writing Rules and Mechanics, Visual Representation and Mechanics, Visual Representation and Information, Final Conclusions and Recommendations.

Prerequisite Courses: ME508



### **6.3.2 Fluid Mechanics**

#### **ME510 Advanced Fluid Mechanic (3 hrs.)**

General Review and Definitions, Description of Fluid Motions, Reynolds Transport Theory, Navier-Stokes Equations, Exact Solution of N.S.Eqs., Applications, Low and High Reynolds Number Flows, Laminar Boundary Layer Theory, Boundary Layer Separation and Control, Approximate and Exact Solutions of Boundary Layer Equation, Turbulent Flow, Inviscid Flow, Simple Plane Flows, Superposition, Drag and Lift.

Prerequisite Courses: ME202, ME302

#### **ME511 Computational Fluid Dynamics (3 hrs.)**

What is Computational Fluid Dynamics?, Grid generation, Non-Dimensionalization of Governing Differential Equation, Finite Difference Solution of Parabolic, Hyperbolic and Elliptic Type Flow Problems, Solution of Ordinary Differential Equations, Convergence and Numerical Stability of Finite Difference Solution for Transient Problems, Direct and Iterative Methods for Linear Systems, Finite Volume Methods, and Time Marching Methods.

Prerequisite Courses: ME202, ME302, ME303, ME301

#### **ME513 Advanced Aerodynamics (3 hrs.)**

Thin and Thick Aerofoils in Incompressible Flow. Limitations of Lifting Line Theory, Concepts of Extended Lifting Line Theory, Lifting Surface Theory, Interaction Problems, Small Perturbation Equations in Compressible Flows: Pradtl-Glauert and Goethert Rules, Ackeret's Supersonic Airfoil Theory, Wings of Finite Span in Incompressible and Compressible Flows, Aerodynamics of the Fuselage and Wing-Fuselage Combination.

Prerequisite Courses: ME202, ME302, ME309, ME409

**ME514 Advanced Gas Dynamics (3 hrs.)**

Introduction, Isentropic Flow, Flow with Friction, Flow with Heat, Generalized One-Dimensional Flow, Unsteady One-Dimensional Flow, Conservation of Mass and Momentum, Wave Interactions, Two-Dimensional Subsonic Flow, Rayleigh-Janzen and, Prandtl-Glauert methods, Two-Dimensional Supersonic Flow, Method of Characteristic.

Prerequisite Courses: ME302

**ME515 Advanced Turbo machinery (3 hrs.)**

Principles of Turbo Machinery, Flow Through Cascades, Blade Theory, Analysis of Axial Turbine Stage, Analysis of Centrifugal Blower, Axial Flow and Radial Flow Gas Turbines, Testing and Control of Fans, Power Transmitting Turbo machines.

Prerequisite Courses: ME202, ME302

**ME516 Two-Phase Flow (3 hrs.)**

Introductory Concepts & Terminology, Flow Patterns, Homogenous Two-phase Flow, Continuity & Momentum Equations, Pressure Gradient Correlations, Separated Two- phase Flow, Bubbly & Plug Flow, Two-phase Flow in Which Inertia Effect Dominates, Void Fraction Correlations, Two-phase Flow Measurements.

Prerequisite Courses: ME202, ME302

**ME525 Hydraulic Systems (3 hrs.)**

Fluid Flow Calculations, Dynamic Hydraulic Systems Analysis, Hydraulic Frequency, Variable Hydraulic Systems Pumps, Linear Control Theory, Hydraulic Pumps, Flow Through Valves, Valve Controlled Systems, Electro-hydraulic Servo Valves, Electro-hydraulic Servo Mechanisms, Conclusions and General Problems.

Prerequisite Courses: ME202, ME302

### **6.3.3 Thermal Science**

#### **ME530 Advanced Thermodynamics (3 hrs.)**

Introductory Concepts, State of Equilibrium, Thermodynamics System, Work and Composite System, Heat and First Law, Second law and Entropy, Availability and Exergy, General Thermodynamics Relationships, Combustion and Thermo chemistry, Probability and Property nature.

Prerequisite Courses: ME203, ME404

#### **ME531 Advanced Heat Transfer / I – Conduction and Radiation (3 hrs.)**

Introductory Concepts, Steady One-Dimensional Conduction, Steady Two- & Three-Dimensional Conduction, Unsteady Conduction (Lumped and Distributed systems, One-; Two-; and Three-Dimensional Problems), Numerical Methods in Conduction Heat Transfer, Radiation Heat Transfer.

Prerequisite Courses: ME301, ME303

#### **ME532 Advanced Heat Transfer / II – Convection and Mass Transfer (3 hrs.)**

Introductory Concepts, Laminar Forced Convection in Closed Conduits, Laminar Forced Convection in External Flow, Turbulent Forced Convection (Internal and External Flows), Natural Convection Heat Transfer, Phase Change Heat Transfer (Condensation and Boiling), Mass Transfer (Diffusive and Convective).

Prerequisite Courses: ME510, ME303

#### **ME533 Advanced Air-conditioning (3 hrs.)**

Psychrometry of Air Conditioning Processes, Heating & Air Conditioning Systems, Evaporating Cooling Systems, Air Conditioning Equipment, Fans & Air Distribution, Pumps & Water Distribution, Desiccant & Dehumidification, Solar Heating & Cooling Systems, Air conditioning Control Systems.

Prerequisite Courses: ME403

**ME534 Advanced Refrigeration (3 hrs.)**

Refrigeration Theory and Vapor Compression Cycle, Refrigerants, Properties and Applications, Refrigeration Equipments, Multiple Stages Refrigeration, Absorption Refrigeration, Adsorption Refrigeration, Steam Jet Refrigeration, Air Refrigeration, Solar Refrigeration, Refrigeration Control.

Prerequisite Courses: ME403

**ME535 Two-Phase Heat Transfer (3 hrs.)**

Study of the Fluid Mechanics and Heat Transfer Processes in Multiphase Systems, Steady State and Transient Models, Boiling Regimes, Correlation for Void, Critical Phenomena, Flow Regimes.

Prerequisite Courses: ME303

**ME536 Nanofluids Heat Transfer(3 hrs.)**

Introduction and Definitions, Applications of Nanofluids, Nanofluids Engineering Parameters, Physical Properties of Nanofluids, Nanoparticles and Nanofluids Preparation, Mechanisms of Heat Transfer and Clustering in Nanofluids, Conduction Heat Transfer, Forced Convection Heat Transfer, Free Convection Heat Transfer, Turbulent flow, Heat Transfer with Phase Change.

Prerequisite Courses: ME202, ME303

**ME537 Solar Energy (3 hrs.)**

Review of Solar Radiation (Solar Constant, Geometry of the Sun, Solar Radiation Calculations and Measurements), Theory of Flat Plate Collectors, Liquid Flat Plate Collectors, Concentrating Collectors, Evacuated Tube Collectors, Solar Water Heating Systems, Solar Air Collectors, Solar Thermal Storage Systems, Solar Heating of Building Systems, and Solar Cooling of Building Systems, Wind Power Generation Systems, Hydro Power Generation Systems, Prototype Design and Simulation. Design of Solar Heating System, Passive Solar Heating.

Prerequisite Courses: ME202, ME203, ME303

**ME539 Advanced Combustion (3 hrs.)**

Spark Ignition Engines: Air-Fuel Ratio, Design of Carburetor, Stages of Combustion, Factors Affecting Knock, Combustion Chambers, Compression Ignition Engines: Stages of Combustion, Factors Affecting Knock, Direct and Indirect Injection Systems, Combustion Chambers, Turbo charging, Thermodynamic Analysis. Engine Exhaust Emission Control: Formation of NOX, HC/CO Mechanism, Smoke and Particulate Emissions and Measurement, Green House Effect, Methods of Controlling Emissions, Three Way Catalytic Converter and Particulate Trap. Alternate Fuels: Alcohol, Vegetable Oils and Bio-Diesel, Bio-Gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability, Engine Modifications, Performance, Combustion and Emission Characteristics. Recent Trends: Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead Cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System Pressure Pick Up, Charge Amplifier PC for Combustion and Heat Release Analysis in Engines.

Prerequisite Courses: ME404

**ME543 Measurements System and Dynamics (3 hrs.)**

Zero Order Instruments, First Order Instruments, Second Order Instruments, Dead Time Elements, Resistance Strain Gauges, Piezoelectric Transducers, Hot Wire and Hot Film Anemometers, Thermocouples, Thermistors, Temperature Measurement Problems in Flowing Fluids, Dynamic Response of Temperature Sensors, Dynamic Compensation of Temperature Sensors, Heat Flux Sensors, Heat Exchanger Dynamics, Manipulating, Computing and Compensating Devices.

Prerequisite Courses: ME202, ME203, ME303, ME402.

### 6.3.4 Applied Mechanics

#### **ME550 Advanced Vibrations (3 hrs.)**

Modeling System, Transformation of Coordinates System, Equation of Motion-Influence Coefficients Lagrange's Equations-Energy Quadratics, Orthogonality of the System, Equator Repeated Eigenvalues, Solutions of the Eigenvalues Problem (Iteration Method, Deflation Method, Characteristics Determinate Extra and Approximations Method), Uncoupled Systems, Response of the System to Forcing, Continuous Systems - Extra Solution, Plate and Membranes, Transfer Matrix Method, Solution of Non-Linear Differential Equation, Finite Elements Method.

Prerequisite Courses: ME305

#### **ME551 Advanced Control (3 hrs.)**

State Space Method, Computer Control Systems, Digital Control Systems, Frequency Response Method, System Compensation, Describing Function. Root Locus for Analysis and Design, State Space Methods, Digital – Control Systems, Frequency Response Methods, System Compensation (Nyquist Stability Criterion – Gain and Phase Margin), Describing functions.

Prerequisite Courses: ME402

#### **ME552 Experimental Stress Analysis (3 hrs.)**

Experimental Techniques, Theory and Application of Photoelastic, Electrical Resistance Strain Gage, Accelerometer Methods for the Experimental Solution of 2-D and 3-D Structures Problems under Static and Dynamic Loadings, Introductions to Holography, Moiré, and Photo-viscoelasticity.

Prerequisite Courses: ME401, ME402

**ME553 Elasticity (3 hrs.)**

Theory of Strain-Tensor Notation, Theory of Stress, Hooke's Law in 2D and 3D, Plane Stress and Plane Strains, Torsion as an Elasticity Problem, Circular and Non-Circular Sections, Airy Stress Functions in Cartesian and Polar Coordinates, Beams Under Elastic Foundations/Pipes: Short and Long, Theory of Circular Plates, Analysis of Cylindrical Shells.

Prerequisite Courses: ME204, ME304

**ME554 Plasticity (3 hrs.)**

The Simple Tension Test, True Stress and True Strain, Anisotropy, Bauschinger effect, Homogeneous Compression, General Approach to Stress Analysis in Plasticity, Idealized Stress-Strain Diagrams, Empirical Equations of Stress-Strain, Instability Condition, Adiabatic Temperature Rises due to Compression of a Work Hardening Material, Brittle and Ductile Material, Effect of Hydrostatic Pressure, Strain Rate, Cold and Hot Working, Yield Criteria of Metals, Shear and Volumetric Resilience, Isotropic Work Hardening, Yield Criterion for an Isotropic Material, Stress-Strain Relations, The Levy-Mises Equations, Work Hardening, Stress-Strain Relation to an Isotropic Work Hardening Material, Mechanics of Metal forming, Sinking of Thin Tubes, Frictionless Tube Sinking, Deep Drawing of Circular Blanks, Wire Drawing, Extrusion, Rolling of Strips, Forming.

Prerequisite Courses: ME204, ME304, ME306, ME401

**ME555 Tribology (3 hrs.)**

Friction (Surface Topography, Measures of Roughness, Contact of Surface, Friction, Mechanism of friction, Amonton's laws, Kinetic friction, Stick-Slip, Wear (Types of Wear, Adhesive Wear, Abrasive Wear, Fatigue Wear, Corrosive Wear, Fretting Wear, Erosion Wear), Lubrication (Types of Lubrication Regimes, The Reynold's Equation,

Hydrodynamic Lubrication, Journal Bearings, Long and Short Bearing Approximations, Boundary Conditions, Finite Bearings, The Finite Difference Method, Bearing Performance Characteristics, Thrust Bearings, Elasto Hydrodynamic Lubrication, Johnson's Chart, Approximate Theory of EHL, Hydrostatic Lubrication, Type of Arrangements, Rectangular Thrust Bearings, Gas Bearings, Advantages and Disadvantages, Gas Bearing Theory).

Prerequisite Courses: ME204, ME304

### **ME558 Fracture Mechanics (3 hrs.)**

Introduction, Linear Elastic Fracture Mechanics, Developments in Non-Linear Fracture Mechanics, S/N Curve, P/S/N Curve.

Prerequisite Courses: ME553

### **ME561 Structure Analysis (3 hrs.)**

A Systematic Approach Formulation of Force and Displacement Method to Analysis, Representation of Structures as Assemblages of Elements, Computer Solution of Structural Systems.

Prerequisite Courses: ME553

### **ME562 Mechanical Behavior of Materials (3 hrs.)**

Overview of Mechanical behavior, Elastic Deformation and Viscoelasticity, Plastic Deformation, Fracture: Macroscopic Aspects, Fracture: Microscopic Aspects, Fracture Testing, Creep and Super plasticity, Fatigue, Composite Materials.

Prerequisite Courses: ME204, ME304

### **ME568 Artificial Intelligence (3 hrs.)**

Introduction to Artificial Intelligence (AI), AI as Representation and search, Structures and Strategies for State Space Search, Heuristic Search, Control and Implementation of State Space Search, Representation for Knowledge-Base



Problem Solving, Languages and Programming Techniques for AI, Advanced Topics for AI Problem Solving.

Prerequisite Courses: ME305, ME402

### **ME569 Composite Materials (3 hrs.)**

Introduction to Composite Materials, Uses of Micromechanics, Macromechanical Analysis of a Lamina, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Strength Failure Theories of an Angle Lamina, Macromechanical Analysis of Laminates, Failure, Analysis, and Design of Laminates, Bending of Laminated Beams, Laminated Beam Buckling, Vibration of Laminated Beam.

Prerequisite Courses: ME304, ME406, ME553.

## **6.3.5 Manufacturing Processes**

### **ME570 Advance Manufacturing / I (3 hrs.)**

Material-Removal Processes: (Mechanics of Chip Formation, Mechanics of Oblique Cutting, Cutting Forces and Power, Model of Temperature Distribution during Cutting. Tool Wear and Failure, Cutting-Tool Materials and Cutting Fluids, Machinability, Nontraditional Machining Processes) ; Casting: (Solidification of Metals, Flow of Molten Metal in Molds, Interdendritic Shrinkage, Micro Segregation and Macro Segregation, Hot Treating, Control of Gas Unsoundness in Castings, Design of Gating System) ; Joining Processes: (Introduction, Oxyfuel Gas, Arc, Resistance, Solid-State Welding, Brazing, Soldering, the Metallurgy of Welding, Weldability, Heat Distribution During Welding, Residual Stress, Distribution, Welding of St-St, Al, Cu and Cast Iron) ; Powder Metallurgy: (Production of Metal Powders, Computation, CIP, HIP, Sintering, Secondary and Finishing Operations, Economics of Powder Metallurgy, Applications, Advantages and Limitations).

Prerequisite Courses: ME205, ME306, ME406

**ME571 Advance Manufacturing / II (2 hrs.)**

Forming: (Introduction, Cold Forming, Hot Forming, Principles of Metal Working Theory) ; Rolling: (Flat Rolling and Flat Rolling Practice, Roll Load, Work Evaluation, Rolling Mills, Lubrication, Defects) ; Forging: (Open and Close-Die Forging, Forgeability, Determination of Plane-Strain Compression Load, Forging Load, Forging-Die Design, Die Materials and Lubrication, Forging Machines, Forging Practice) ; Extrusion: (Extrusion Process and Practice, Hot and Cold Extrusion, Metal Flow in Extrusion, Impact and Hydrostatic Extrusion, Defects, Extrusion Force Calculation) ; Wire Drawing: (Drawing Processes and Practice, Determination of Drawing load, Maximum Reduction of area Pre Pass with and without friction, Defects and Residual Stresses, lubrication) ; Sheet-Metal Forming: (Shearing, Sheet-Metal Characteristics, Formability of Sheet Metals, FL-Diagram, Bending Sheet and Plate, Deep Drawing, Deep Drawability, Deep-Drawing Practice, Spinning) ; Theory of Metal working.

Prerequisite Courses: ME205, ME306, ME406, ME570

**ME572 Machining Processes (3 hrs.)**

Mechanics of 2-D and Basic 3-D Cutting, Industrially-Applicable Mechanistic Force Models for Practical Processes ( Including Turning, Facing, Boring, Face Milling, End Milling, and Drilling), Surface Generation and Wear-Based Economic Models.

Prerequisite Courses: ME570

**ME573 Welding (3 hrs.)**

Introduction to Materials Engineering, Welding Processes and Equipment 1 & 2, Design of welded Structures, Management of Weld Quality, Advanced Welding Processes, Welding Metallurgy, Welding Systems.

Prerequisite Courses: ME205, ME306, ME406

### **6.3.6 Engineering Materials**

#### **ME580 Advanced Engineering Materials / I (3 hrs.)**

Introduction to Metallic Materials, Iron-Carbon System, Microstructure of Carbon Steel, Classification of Carbon Steel, Cast Irons: Composition, Structure, Properties and Applications, Alloy Steel, Effect of Alloy Elements on: Polymorphic Transformation, Formation of Carbides, Stability of Carbides, Grain Growth, Eutectoid Point, Retardation of transformation Rate, Microstructure, Nickel Steel, Chromium Steel, Heat Treatment of Steel: Homogenizing, Full Annealing, Normalizing, Shearoidizing, Process Annealing, Quench Hardening, Tempering, Isothermal Transformation of Austenite, Nonferrous Metals, Copper and Copper Base Alloys, Aluminum and its Alloys, Aging of Aluminum Alloys, Titanium Alloys and its Application, Magnesium Alloys and its Application.

Prerequisite Courses: ME205, ME406

#### **ME581 Advanced Engineering Materials / II (3 hrs.)**

Introduction to Polymers, Polymerization Process, Classification of Polymers, Thermoplastics: Polyethylene, Polypropylene, Poly (Vinyl Chloride), And Polystyrene, Thermosetting: Phenolic, Epoxies, and Certain Polyesters, Elastomers: Natural rubber (vulcanized). Synthetic rubbers, Polymers Processing, Extrusion, Injection Molding, Blow Molding, Rotational Molding, Transfer Molding , Ceramics: Definition, Properties of Ceramics, Categories of Ceramics, Ceramic Products, Traditional Ceramic, New Ceramics: Oxides, Carbides, Nitrides, Glass, Graphite, Boron, Composites, Metal Matrix Composites, Polymer Matrix Composites, Ceramic Matrix Composites, Forms of Reinforcement, Matrix Materials, Reinforcement Materials, Manufacturing of Polymer – Matrix Composites.

Prerequisite Courses: ME205, ME406, ME580

### **6.3.7 Industrial Engineering**

#### **ME590 Operation Research / I (2 hrs.)**

Introduction to Operation Research, Linear Programming, The Simplex Method, Duality, Sensitivity Analysis, Transportation Models, Assignment Models, Network Analysis, Linear Programming.

Prerequisite Courses: ME306, ME405

#### **ME591 Operations Research / II (2 hrs.)**

Decision Analysis, Games Theory, Markovian Decision Process, Queuing Theory, Simulation Models, Dynamic Programming.

Prerequisite Courses: ME306, ME405, ME590

#### **ME592 Advanced Statistics (2 hrs.)**

Introduction to Statistics, Variables and Graphs, Frequency Distribution, Moments of Statistics, Probability Theory, The Binomial, Normal, and Poisson Distributions, Sampling Theory, Statistical Estimation Theory, Tests of Hypothesis Different types of Tests, Data analysis, Analysis of Variance, Linear Regression, Linear Correlation, and Multiple Correlations.

Prerequisite Courses: ME101, ME201, ME106, ME207, ME306

#### **ME593 Quality Control (3 hrs.)**

Introduction to Quality Control, Product Quality Inspection, Acceptance Sampling, Control Charts, Process Capability, International Standards Acceptance Sampling Plans.

Prerequisite Courses: ME405

#### **ME594 Production Planning (3 hrs.)**

Introduction to Production Planning and Control, Functions of Production Planning and Control, Types of Factories, Organization of Factories, Economical Analysis of Factories, Forecasting the production, Capacities and Their Determination, Materials and Processes, Scheduling,

Loading, Follow-up, Quality Control, Cost Control, Economic Batch Quantity.

Prerequisite Courses: ME306, ME405

### **ME595 CAD/CAM (3 hrs.)**

Introduction to Computer Aided Design and Manufacturing, CAD/CAM Integration, Using Finite Elements Analysis Techniques and Design Analysis in 1D, 2D, & 3D, CNC Machines and Their Programming, Convergence Technique, Optimization, Group Technology, CAD/CAM Programs Used in Industry, Auto-CAD Interfacing.

Prerequisite Courses: ME306, ME401

### **ME596 Maintenance Planning and Control (3 hrs.)**

Introduction to Maintenance, Designing Maintenance Procedures in Industry, Analysis of Preventive and Emergency Maintenance, Procedures to Minimize Errors, Worker Safety, Maintenance Planning, Spare Part Provisioning, Replacement Analysis, Reliability Engineering and Analysis, Computer Aided Maintenance.

Prerequisite Courses: ME104, ME306



## 6.4 Description of Ph.D. Courses

### 6.4.1 Mathematics and Language

#### **ME601 Advanced Mathematics / Finite Element Method FEM (3 hrs.)**

Basic Fundamentals of FEM and its Applications in Heat Transfer and Fluid Flow, Introductory Concepts and Formulations, FEM for One-Dimensional Problems, FEM for Two-Dimensional problems, FEM for Axisymmetric Problems, FEM for Time-Dependent Problems, FEM for Three-Dimensional Problems.

Prerequisite Courses: ME501, ME303, ME202

#### **ME602 Advanced Mathematics / Boundary Element Method BEM (3 hrs.)**

Basic Fundamentals of BEM and its Applications in Heat Transfer, Fluid Flow, Elastostatic and Elastodynamic Problems, Introductory Concepts and Principles, BEM for Steady State Two-Dimensional Field Problems, BEM for Steady State Two-Dimensional Elasticity Problems, BEM for Steady State Three-Dimensional Elasticity Problems, BEM for Axisymmetric Problems, BEM for Time-Dependent Problems.

Prerequisite Courses: ME501, ME303, ME304, ME202, ME204

#### **ME608 English Language / I (1 hr.)**

Parts of Speech, Punctuation, Kinds of Sentences, Pronouns, Verb Tenses, Numbers, Phonetics, Agreement of Subject and verb, Definite and Indefinite Articles, Spelling, How the Suffix "S" is pronounced, Preposition of Time, Model Verbs, Phrasal Verbs.

Prerequisite Courses: None

#### **ME609 English Language / II (1 hr.)**

Technical Reporting: Fundamental Principles, General Procedure, Technical Description, Reports, Theses and Dissertations, Technical Papers and Articles, Oral Reports and Speaking in Public, Writing Rules and Mechanics, Visual



Representation and Mechanics, Visual Representation and Information, Final Conclusions and Recommendations.

Prerequisite Courses: ME608

## **6.4.2 Fluid Mechanics**

### **ME610 Turbulence (3 hrs.)**

Introduction, the Nature of Turbulence, Method of analysis, Turbulent Transport of Momentum and heat, Reynolds Equations, Estimate of the Reynolds Stress, Prandtl Mixing Length Theory, The Dynamics of Turbulence, Pure Shear Flow, Reynolds Stress, Vorticity in Turbulent Flows, Wall-Bounded Shear Flows, Turbulent Flows in Pipes and Channels, Spectral Dynamics, One- and Three Dimensional Spectra.

Prerequisite Courses: ME510

### **ME613 Fluid Transient (3 hrs.)**

Transient Flow Concepts, Arithmetic Derivation of Transient Flow Equations, Effect of Air Entrainment, Cause of Transient, Column Separation, Method of Analysis, Basic Differential Equations for Transient Flow, Waves Speed in Special Conduits, Characteristic Equations, Finite Difference Equations, Basic Boundary Conditions, Single Pipeline Applications, Equations for Water Hammer, Single Pipe with Reservoir, Pipes in Series, Lumped Elements, Air Chamber, Transient Caused by Turbo Pumps, Methods for Controlling Transient.

Prerequisite Courses: ME202, ME302

## **6.4.3 Thermal Science**

### **ME630 Selected Topics in Heat Transfer / I (3 hrs.)**

Individual or group study of selected topics in conduction and radiation heat transfer under the supervision of the instructor. The course involves continuous study during the course period for the selected topics. The load of the course is carried mainly by the students, with a continuous supervision, guidance, and

instruction of the course instructor. At the end of the course, a seminar for the topics under study should be submitted by the students. The study could be made either individually or by a group of students, depending on the degree of complexity of the topics subjects, and also on the number of students attending the course.

Prerequisite Courses: ME531

### **ME631 Selected Topics in Heat Transfer / II (3 hrs.)**

Individual or group study of selected topics in convection heat and mass transfer under the supervision of the instructor. The course involves continuous study during the course period for the selected topics. The load of the course is carried mainly by the students, with a continuous supervision, guidance, and instruction of the course instructor. At the end of the course, a seminar for the topics under study should be submitted by the students. The study could be made either individually or by a group of students, depending on the degree of complexity of the topics subjects, and also on the number of students attending the course.

Prerequisite Courses: ME532

### **ME632 Cryogenics (3 hrs.)**

Introduction to Cryogenic Systems, Low-Temperature Properties of Engineering Materials, Gas-Liquefaction Systems, Separation and Purification Systems, Cryogenic Refrigeration Systems, Measurement Systems for Low Temperatures, Cryogenic-Fluid Storage and Transfer, Vacuum Technology.

Prerequisite Courses: ME403, ME530

### **ME633 New and Renewable Energies(3 hrs.)**

Solar Energy: Review of Solar Radiation (Solar Constant, Geometry of the Sun, Solar Radiation Calculations and Measurements), Theory of Various Types of Collectors, Solar Thermal Storage Systems, Solar Heating of Building



Systems, and Solar Cooling of Building Systems, Prototype Design and Simulation. Design of Solar Heating System, Passive Solar Heating.

Wind Energy: Wind Characteristic, Total Energy and Force Distribution, Dynamic Matching, Wind Turbine Operation, Availability Factor.

Biomass: Energy Farming, Energy Analysis, Direct Combustion for Heat, Pyrolysis, Fermentation, Digestion for Biogas, Design of Digester.

Prerequisite Courses: ME302, ME537

### **ME634 Heat Transfer in Porous Media (3 hrs.)**

Fundamental Principles for Heat Transfer and Fluid Flow in Porous Media, Local Volume Averaging, Conduction Heat Transfer, Forced Convection, Natural Convection, Phase Change Heat Transfer.

Prerequisite Courses: ME531, ME532

## **6.4.4 Applied Mechanics**

### **ME650 Structural Dynamics (3 hrs.)**

Structural Design for Dynamic Loads, Model Analysis of Multi Degrees System, Dynamic Load Factor, Elasto-Plastic System Due to Dynamic Load, Rigid Body Kinematics, Inertial Properties, Eulers Equation, Rigid Body Kinetics-Inertial, Properties of Eulers Equation, Rotation About a Point-Space Motion, Lagrange's Equation, Hamilton's Principle.

Prerequisite Courses: ME305, ME553, ME554

### **ME651 Energy Methods in Applied Mechanics (3 hrs.)**

Principles of Virtual Work, Problem Formulation, Principles of Strain Energy, Complementary Energy Applications; Method of Calculus of Variation, Euler Method, Lagrange Method, Direct Methods, Rayleigh Ritz-Method, Galerkin's Method, Kontbrovitch Method, Applications; Plate Bending and Stretching, Energy Method in Vibrations, Rayliegh's

Energy, Galerkin Walosor Method, Application of Energy principles in Shell Problems, Energy Principles for Buckling of Plates, Optimization Techniques, Applications: Beams and Plates.

Prerequisite Courses: ME204, ME304, ME553, ME554

### **ME652 Plates and Shells (3 hrs.)**

Plates: Theory of Thin plates with Small Deflection, Kirchoff's Hypothesis, Differential Equation of Bending, Rectangular Plates with Various Edge Conditions and Loadings, Navier and Levy's Solutions, Plates with Different Shapes (Triangular, Elliptical), Plates under Elastic Foundation, Stability of Plates, Large Deflection of Plates, Thick Plates.

Shells: Three Dimensional Differential Geometry, Membrane Theory of Shells, Sheets of Revolution with Symmetric and Un-Symmetric Loading, Spherical and Cylindrical Shells, Shallow Shells, Bending Theory of Shells, Cylindrical Shells, Shallow Shells.

Prerequisite Courses: ME204, ME304, ME553, ME554

### **ME653 Advanced Mechanical Behavior of Materials (3 hrs.)**

Macroscopic Elasticity and Plasticity, Viscoelasticity, Yielding, Yield Surfaces, Work Hardening, Geometric Dislocation Theory, Creep, Temperature Dependent and Environment Dependent Mechanical Properties.

Prerequisite Courses: ME562

### **ME654 Approximate Methods in Mechanical Engineering (3 hrs.)**

Orthogonal and Nonorthogonal Expansions, Matrix Algebra and Algebraic Eigen value Problems, Finite Difference Formulation and Solution, Integral and Variational Approaches to Finite Element Formulation, Solution by Electronic Calculators and Digital Computers, Application to Heat Transfer and Fluid and Solid Mechanics.

Prerequisite Courses: ME500, ME501

**ME655 Analysis and Design of Control Systems (3 hrs.)**

Review of Continuous Control, Introduction to Digital Control, Discrete System Analysis, Sampled Data Systems, Discrete Equivalences, Design Using Transform Techniques, Implementation of Direct Digital Control Algorithms, Introduction to Real – Time Systems.

Prerequisite Courses: ME402, ME551

**ME656 Fracture, Fatigue and Creep (3 hrs.)**

Standard Specimen Fatigue, Stress Concentration, Crack Initiation, Linear Elastic Fracture Mechanics, Developments in Non-Linear Fracture Mechanics, Low Cycle Fatigue, Fractographic and Probabilistic Aspects of Fatigue Failure, Stress Concentration, Planning and Analysis of Probit, SNP and Response Tests, Mechanisms of Fatigue Design, Fail Safe vs. Safe Life Design, Crack Propagation.

Prerequisite Courses: ME558

**ME657 Advanced Composite Materials (3 hrs.)**

Advanced Topics in Composite Materials Mechanics (Including Analysis, Design, and Optimization of Composite Structures), Failure Theories for Composites (Including Composites with Holes, Analysis and Design of Joints, Fatigues of Composites).

Prerequisite Courses: ME569

**ME662 Automation and Robotics (3 hrs.)**

Introduction, Goals and Applications of Automation, Hard Automation, Soft Automation, NC & CNC Machine, Historical Background, Advantages and Limitations, Principles of NC & CNC Machines, Types of Control System, Programming for NC & CNC, Computer-Aided Programming, G-Code Adaptive Control Principles & Applications, Material Handling & Movement, Automated Production Lines, Industrial Robots Components, Classification, Selection of Robots,

Applications (Material Handling, Spot Welding, Spray Painting, Automated Assembly, Inspection), Automated Measurement.

Prerequisite Courses: ME551

### **ME663 Advanced Fracture Mechanics (3 hrs.)**

Asymptotic Crack Tips Field in Linear Elastic Fracture Mechanics Leading to the Stress Intensity Factor, Energy Release Rate, Crack Tip Opening Displacement Characterization, Elastic-Plastic Fracture Mechanics in both Small-Scale Yielding and Large-Scale Yielding Characterized by Path Independent Integrals, Micro-Mechanics of Fracture, Fracture along Bi-Material Interface.

Prerequisite Courses: ME558

## **6.4.5 Manufacturing Processes**

### **ME 670 Advanced Casting Technology (3 hrs.)**

Introduction and Types of Foundries, Mould and Mould Making, Melting and Pouring, Gating Systems, Finishing Processes, Advance Casting Processes, Inspection and Testing of Casting, Modernisation and Mechanization of Foundry, Economics of Casting

Prerequisite Courses: ME570

### **ME 671 Automatic Control of Manufacturing Processes (3 hrs.)**

Computer Control System Structure, Process Modeling and Dynamics, Feedback Control, Enhanced Controllers, Digital Controllers, Model Predictive Control, Advanced Control Topics, Case Studies for Process Control Systems, Hands on Control System Design Using Simulink and MATLAB.

Prerequisite Courses: ME595

**ME 672 Advanced Welding Technology (3 hrs.)**

Laser Properties and Fundamentals, Laser Optics and Optical Materials, Laser Material Interaction, Laser Welding Including Hybrid Processes, Laser Cutting and Drilling, Laser Surface Treatment, Laser Material Processing Systems, Advanced Digital Arc Welding, Flux Cored Arc Welding, Advanced Modeling and Monitoring of Resistance Welding, Friction Stir Welding, Additive Manufacture, Residual Stress, Distortion and Their Management.

Prerequisite Courses: ME571, ME573

**ME696 Computer Integrated Manufacturing (CIM) (3 hrs.)**

Introduction to CIM, The One Model Concept, Data Base Management Systems, Networking Concept, OSI Fundamentals, MAP/TOP Fundamentals, Developing a Successful CIM Strategy, Computer Aided Process Planning Systems, Dynamic Production Planning and Control.

Prerequisite Courses: ME595

**6.4.6 Engineering Materials****ME 680 High Temperature Materials (3 hrs.)**

Creep: Factors Influencing Functional Life of Components at Elevated Temperatures, Definition of Creep Curve, Various Stages of Creep, Metallurgical Factors Influencing Various Stages, Effect of Stress, Temperature and Strain Rate ; Design for Creep Resistance: Design of Transient Creep Time, Hardening, Strain Hardening, Expressions of Rupture Life of Creep, Ductile and Brittle Materials, Monkman-Grant Relationship ; Fracture: Various Types of Fracture, Brittle to Ductile From Low Temperature to High Temperature, Cleavage Fracture, Ductile Fracture Due to Micro Void Coalescence-Diffusion Controlled Void Growth; Fracture Maps for Different Alloys and Oxides ; Oxidation and Hot Corrosion: Oxidation, Pilling, BedworthRatio, Kinetic Laws of Oxidation- Defect Structure and Control of Oxidation by Alloy Additions, Hot Gas Corrosion Deposit, Modified Hot Gas Corrosion, Fluxing Mechanisms, Effect of Alloying

Elements on Hot Corrosion, Interaction of Hot Corrosion and Creep, Methods of Combat Hot Corrosion; Superalloys and other Materials: Iron Base, Nickel Base and Cobalt Base Super Alloys, Composition Control, Solid Solution Strengthening, Precipitation Hardening by Gamma Prime, Grain Boundary Strengthening, TCP Phase, Embrittlement, Solidification of Single Crystals, Intermetallics, High Temperature Ceramics.

Prerequisite Courses: ME580, ME581

### **ME 681 Advanced Composite Materials (3 hrs.)**

Introduction to Composite Materials, Uses of Micromechanics, Macromechanical Analysis of a Lamina, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Strength Failure Theories of an Angle Lamina, Macromechanical Analysis of Laminates, Failure, Analysis, and Design of Laminates, Bending of Laminated Beams, Laminated Beam Buckling, Vibration of Laminated Beam.

Prerequisite Courses: ME304, ME406, ME553.

## **6.4.7 Industrial Engineering**

### **ME692 Groups Technology (3 hrs.)**

Introduction to Advanced Production Planning; Application of Quantities and Heuristic Methods in Production Planning; Material and Capacity Planning, Mathematical Models for Inventory Systems; Sequencing and Scheduling; Assembly Line Balancing Methods; Just-in-Time Manufacturing; Lean Production and Manufacturing Systems; Design Kanban System; Group Technology and Cellular Manufacturing.

Prerequisite Courses: ME594

### **ME693 Expert Systems (3 hrs.)**

Introduction to Intelligent Systems and Applications, Systems Theory (Mathematical Models, Operators, System Response, Linear and Non-Linear Systems, Cellular Automation, Stability, Intelligent Systems), Artificial Neural

Networks, Fuzzy Logic, Probabilistic and Evolutionary Algorithms, Expert and Knowledge-Based Systems.

Prerequisite Courses: ME595

### **ME694 Advanced Industrial Quality Control (3 hrs.)**

Statistical Inference about Process Quality, Statistically and Economically-Based Treatment of Sampling Plan, Process Measurement and Capability Analysis, Failure Mode and Effect Analysis (FMEA), Quality Assurance Framework, Advanced Quality Management Practical Consideration in Developing QA/QC Systems, Experiment Design and Analysis of Variance in Quality Control, Total Quality Management, Lean and Six Sigma, Zero Defect Systems, ISO 9001-2000.

Prerequisite Courses: ME593

### **ME697 Optimization in Engineering Design (3 hrs.)**

Introduction to Multidisciplinary System Design Optimization, Modeling and Simulation, Design of Experiments, Numerical Optimization, Sensitivity Analysis, Simulated Annealing, Genetic Algorithm, Goal Programming Iso performance, Multi-Objective Optimization, Post Optimality Analysis, Design of Value, Design for Flexibility.

Prerequisite Courses: ME501

### **ME699 Reliability (3 hrs.)**

Introduction to Reliability Engineering (Introduction, Measuring Reliability, Design for Reliability, Reliability Management), Reliability and Safety Assessment, Active Fault-Tolerant System Design, Standardizing Availability Definition, Systems Maintainability Analysis and Measures, Quantifying Reliability and Maintenance Strategies (Modeling of Multi-Components Systems).

Prerequisite Courses: ME593



## **6.5 Description of Courses from Undergraduate Program**

### **6.5.1 Mathematics and Language**

#### **ME101 Mathematics / I (4 hrs.)**

Functions and Limits, Continuity, Logarithmic and Trigonometric Functions, Conic Sections. Differentiations and its Applications, Integration and its Applications, Methods of Integration, Matrices and Determinants, Introduction to Vectors, Complex Numbers.

#### **ME106 Programming / I (3 hrs.)**

Definitions of Computer And its Various Units and Terminals, Windows Operation System, Introduction to Programming by QBASIC Language, Algorithms and Flow Charts, Methods of Data Input and Output, Results Output, Arithmetic Sentences, Symbols of Arithmetic Operations, Rules of Algebraic Expressions Writing and Priority Rules, Mathematical Library Functions, Control Statements, DO Loops in Their Various Forms, 1-D and 2-D Arrays, Results Output in Tables Form, User Functions ( Single Row Sub- Functions ), Computer Applications in The above Subjects.

#### **ME201 Mathematics / II (4 hrs.)**

Review of Integral Methods, Partial Differentiation, Planes, Double Integral, Complex Functions, Polar Coordinates, Vectors, Directional Differentiation, Line and Surface Integrals, Cramer ' s Theory, Divergence Theory of Gauss, Infinite Series and Sequences, Ordinary Differential Equations.

#### **ME207 Programming / II (5 hrs.)**

Introduction to programming by FORTRAN language, Methods of Data Input and Results Printing, Arithmetic Sentences, Symbols of Arithmetic Operations, Rules of Algebraic Expressions Writing and Priority Rules, Mathematical Library Functions, Control Statements, DO Loops in Their Various Forms, 1-D And Multi-Dimensional Arrays, User Functions and Subroutines,



Files, Operation And Use Of AUTOCAD Software, Computer Applications in the Above Subjects. Computer Interfacing: Introduction to Digital Electronics, Standard Interfaces, Bus Interface, Sensors, Actuators and Solenoids, Motors, Experimental Interface Projects

### **ME301 Engineering and Numerical Analysis (5 hrs.)**

Engineering Analysis: The Special Functions, Laplace Transformation, Convolution and Inverse Convolution Theorem, Applications in Ordinary Differential Equations, Fourier Series, Complex Fourier Series, and Partial Differential Equations.

Numerical Analysis: Numerical Methods, Finite Differences, Numerical Differentiation and Integration, Numerical Solution of Partial Differential Equations, Numerical Double Integration, Trapezoidal Method, Simpson Method, Applications on Computer in the Subjects of Numerical Analysis by Using MATHCAD and MATHLAB Softwares.

## **6.5.2 Fluid Mechanics**

### **ME202: Fluid Mechanics / I (4 hrs.)**

Introduction to Fluids Science, General Concepts and Definitions, Fluid Statics, Pressure Distribution, Hydrostatic Forces on Submerged Surfaces and Bodies, Stability of Submerged and Floating Bodies, Accelerated Fluids, Fluid Flow Concepts (Continuity, Energy and Momentum Equations and Their Applications), Dimensional Analysis and Similitude, Viscous Fluid Flow (Laminar Flow Between Two Plates and Through Circular Tubes, Boundary Layer, Pipe Flow and Frictional Losses and Moody Diagram, Minor Losses), Flow Measurements, Networks of Pipes and Pumps.

### **ME302 Fluid Mechanics / II (4 hrs.)**

Turbomachinery: Introduction and General Principles, Similarity Laws, Centrifugal Pumps, Impulse Turbines, Reaction Turbines, Axial Flow Compressors, Centrifugal Compressors, Gas Turbines.

Gas Dynamics: General Principles Of Compressible Fluid Flow, One-Dimensional Isentropic Varying Area Flow, Normal and Oblique Shocks, Nozzles, Diffusers, Jet Propulsion, Constant Area Flow ( Fanno Line And Rayleigh Line Flows ).

### **ME309 Introduction to Aeronautical Science (4 hrs.)**

Introduction to Aerodynamics: Lift and Drag Generation, Lift Wings, Airfoils Theories, Types of Wings. Boundary Layer on Wings, Boundary Layer Control, Drag, Theories of Drag and Preliminary Calculations of Drag and Lift, Introduction To Aircraft Stability, Take – Off and Landing, Aircrafts Performance.

Gas Dynamics: General Principles of Compressible Fluid Flow, One-Dimensional Isentropic Varying Area Flow, Normal and Oblique Shocks, Nozzles, Diffusers, Jet Propulsion, Constant Area Flow (Fanno Line and Rayleigh Line Flows).

### **ME409 Aerodynamics (3 hrs.)**

Fluid Dynamics Fundamentals, Potential Flow Theory, Aerodynamics of Wings and Streamlined Surfaces, Viscous Flow Theory and Boundary Layer, Three – Dimensional Finite Wings in Incompressible Flow, Streamlined Surfaces In Two – Dimensional Flow, Compressible Flow Over Finite Three – Dimensional Wings, Numerical Methods in Aerodynamics.

## **6.5.3 Thermal Science**

### **ME203 Thermodynamics (3 hrs.)**

Introduction, Definitions, Heat, Work, Power, Internal Energy, Enthalpy, Zeroth Law of Thermodynamic, Temperature and Its Measurements, 1<sup>st</sup> Law of Thermodynamic, Boyle 's Law, Charles 's Law, Perfect Gas Law, Closed Systems Processes, Open Systems Processes, Energy Equation For Steady Flow and Its Applications, Reversible and Irreversible Processes, Heat Engine and Reversible Heat Engine, 2<sup>nd</sup> Law of Thermodynamic, Carnot Cycle and Reversed Carnot Cycle, Entropy, Clausius Inequality, Gases Mixtures, Cycles.

**ME303 Heat Transfer (3 hrs.)**

General Concepts and Definitions, Modes of Heat Transfer, Conduction Heat Transfer, Extended Surfaces (Fins), Two-Dimensional Problems, Unsteady Conduction Heat Transfer, Heisler Charts, Forced Convection Heat Transfer, Thermal Boundary Layer, Heat Transfer In Pipes For Laminar and Turbulent Flow, Natural Convection Heat Transfer, Heat Exchangers, Radiation Heat Transfer: General Principles, Configuration (Shape ) Factor, Radiation Applications.

**ME403 Air - Conditioning and Refrigeration (4 hrs.)**

Air and Humidity Calculations, Physiological Reactions For Cooling and Heating, Thermal Calculations and Heating Systems, Air – Conditioning and Cooling Calculations, Classification of Air Ducts, Design of Air Ducts For Air Distribution Systems, Ventilation and Air Cleaning, Units of Cooling and Adsorption and Compression, Cold Storages and Low Temperature Cooling Requirements, Methods of Automatic Control. (For Aeronautical Students, Focusing Is Made on Aircrafts Air – Conditioning).

**ME404 Power Engineering (4 hrs.)**

Power Engineering: Introduction, Steam Power Cycles, Steam Boilers, Heat Exchangers, Steam Turbine and Accessories, Gas Power Cycles, Gas Turbine, Water Power Cycles.

Internal Combustion Engines ( I.C.E. ):Heat Engines, Classification Of Internal Combustion Engines, Four Strokes I.C.E., Two Strokes I.C.E., Air Standard and Actual Cycles, Combustion, Theories of Detonations, Designs of Combustion Chambers, Knock Phenomena.



### 6.5.4 Applied Mechanics

#### **ME102 Engineering Mechanics (5 hrs.)**

Statics: Introduction and Fundamental Concepts, Force Vectors Analysis, Equilibrium of Particles, Force Systems Resultant, Moments and Couples, Equilibrium of Rigid Bodies, Analysis of Trusses and Structures, Friction, Center of Gravity and Centroids, Moment of Inertia.

Dynamics: Introduction To Dynamics, Absolute Motion, Relative Motion, Kinematics of Particles, Kinetics of Particles, Kinematics of Rigid Bodies, Kinetics of Rigid Bodies, Newton's 2<sup>nd</sup> Law, Work and Energy, Impulse and Momentum.

#### **ME204 Mechanics of Materials and Machines (4 hrs.)**

Mechanics Of Materials: Simple and Normal Stress, Shear Stress, Bearing Stress, Thin Cylinder, Simple Strain, Hook's Law, Axial Deformations, Statically Indeterminate Parts, Thermal Stresses, Torsion, Flanged Circular Coupling, Springs, Shear and Moments in Beams, Shear and Moments Diagrams, Stresses in Beams.

Mechanics Of Machines: Velocity and Acceleration and Forces Diagrams in Mechanisms, Friction Applications (Brakes and Clutches, Belts, Ropes and Chains), Turning Moment Diagram, Flywheel, Cams, Hook's Joint,

#### **ME304 Strength of Materials (3 hrs.)**

General Review, Loading Stresses for Unsymmetrical Beams, Shear Stresses in Beams, Compound Beams, Deflection and Bending in Beams, Double Integral Method, Area-Moment Method, Statically Indeterminate Beams, Three Moments Equation, Compound Stresses, Eccentrically Loaded Parts, Mohr's Circle For Stresses and its Applications, Mohr's Circle for Strains, Struts, Euler Equation for Long Struts, Failure Theories.

#### **ME305 Mechanics of Machines and Vibrations (3 hrs.)**

Mechanics of Machines: Gears, Gear Trains, Gyroscopic Moment, Governor, Balancing of Rotating Masses, Balancing of Reciprocating Masses.

Vibrations: General Principles, Oscillatory Motion, Free Vibrations, Damped Vibrations, Forced Vibrations, Harmonic Vibration, Whirling Speed of Rotating Shafts, One- and Two- and Multi- Degrees of Freedom Systems.

### **ME401 Design of Machine Elements (6 hrs.)**

Introduction to Simple and Compound Stresses and Deformations and their Applications, Failure Theories and their Applications, Stresses Concentration in Machine Elements, Fatigue Stresses, Riveted Joints, Welded Joints, Bolted Joints, Couplings and Keys, Pressure Vessels, Power Screws, Rotating Shafts, Spur and Helical Gears, Chains Drives, Belts, Brakes and Clutches, Roller and Sliding Bearings, Springs, Problems in Design, Applications on Computer By Using ANSYS Software.

### **ME402 Control and Measurements (3 hrs.)**

Introduction to Control Systems, General Mathematical Review (Laplace Transformation , Partial Fraction Expansion , Differential Equations , Matrices), Mathematical Modeling of Mechanical and Fluids and Thermal Systems, Transient and Steady State Response, Root Locus Method, Introduction To Measurement, Measurements Sensors and Instruments, Temperature and Pressure Measurements, Force and Mass and Torque Measurements, Translational and Angular Motion Measurements.

## **6.5.5 Manufacturing Processes**

### **ME104 Principles of Production Engineering (4 hrs.)**

Production of Metals, Rawson Iron, Production of Raw and Cast Iron, Production of Ingots, Production of Non-Ferrous Metals (Aluminum, Copper, Lead), Physical Properties of Metals, Mechanical Properties of Metals, Mechanism of Metals Solidification, Defects of Ingots, The Measurement and Marking-Out, Hand Tools, Metals Machining, Casting, Hot and Cold Working, Plastics, Glass and Ceramics, Metals Joining, Industrial Safety, Practical Training Hours In The

Mechanical Workshop and Measuring Instruments Laboratory (Turning, Forging, Fitting, Carpentry, Measuring Instruments).

### **ME306 Principles of Manufacturing Processes (4 hrs.)**

Casting Processes, Metals Machining Processes, Plastics, Powder Metallurgy, Welding Processes, Metals Cold Working, Metals Hot Working, Engineering Statistics (Statistical Methods, Specimens, Central Tendency, Scales of Variations, The Frequency Distribution, The Relationship Between The Specimens and The Population, Basics of Probability Theory, Probability Distribution, Tests of Significance), Practical Training Hours in The Mechanical Workshop and Measuring Instruments Laboratory (Turning, Forging, Fitting, Carpentry, Measuring Instruments).

## **6.5.6 Engineering Materials**

### **ME205 Engineering of Metallurgy (2 hrs.)**

Introduction To Metallic and Non-Metallic Materials, Crystal and Micro-Structure of Metals and Alloys, Crystallization and Solidification Process and Cooling Curves, Thermal Equilibrium Diagrams, Thermal Equilibrium Diagrams of Iron and Carbon, Relation Between Micro-Structure and Mechanical Properties, Basic Heat Treatments For Iron and Alloys, Light Metals, Copper and Zinc and Their Alloys, Hardening.

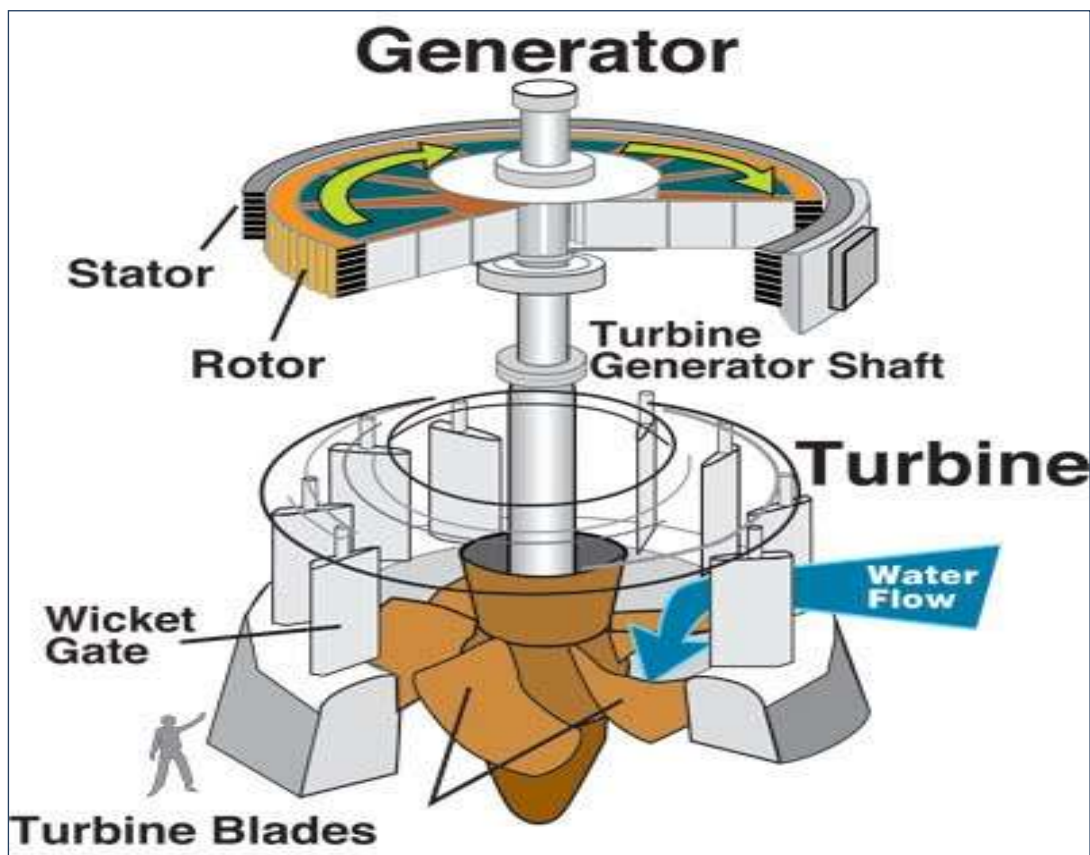
### **ME406 Engineering Materials (2 hrs.)**

Mechanical Properties, Corrosion and Cathodic Protection, Carbon Steel, Low Alloy Steel, High Temperature and Oxidation and Stain Resistant Steel, Tools and High Speed Steel, Copper and Its Alloys, Aluminum Alloys, Nicle Alloys, Thermal and Insulating Materials, Engineering Inspections, Compound Materials, Plastics, Ceramics.

## 6.5.7 Industrial Engineering

### ME405 Industrial Engineering (3 hrs.)

Introduction to Industrial Engineering, Benefit Study, Plant Layout, Handling, Work and Time Study, Motion Study, Inventory Control, Maintenance, Networks, Linear Programming, Transportation Problems, Assignment, Production Cost Control Calculations, Depreciation, Forecasting, Sequence, Quality Control (Measurements and Specifications, Quality Concepts, Economics of Quality, Numerical Methods of Quality Control, Inspections By Specimens, Process Capability, Pareto Chart, Regression Chart, Cause and Effect Chart, Brains Troming, Flow Diagram, Tree Diagram, Reliability Theory, Total Quality Management (TQM).





## 7. The Faculty and their Lines of Research

The following is a list of some faculty staff that teaches and/or supervises M.Sc. and Ph.D. students in the department.

**Prof. Dr. Khalid Ahmed Joudi:** B.Sc. & M.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Colorado, Boulder, Colorado U.S.A, & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Manchester Institute of science & Technology, Professor of Mechanical Engineering – Thermo fluids, Air Conditioning and Refrigeration, Heat Transfer (Free, Forced and Mixed Convection), Solar Energy, Renewable Energy



**Prof. Dr. Najdat Nashat Abulla:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Mosul, M.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. Michigan State University, Professor of Mechanical Engineering – Thermo fluids, Aerodynamics, Turbulent flow, Flow Control, Boundary Layer Flow, Transient Flow.



**Prof. Dr. Qasim Muhammad Doos:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, M.Sc., & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Professor of Mechanical Engineering – Manufacturing, Industrial and Manufacturing Engineering, Manufacturing processes, Casting, Automation of Manufacturing.



**Prof. Dr. Ihsan Y. Hussain:** B.Sc. 1986, M.Sc. 1989, & Ph.D. 1997 in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Professor of Mechanical Engineering – Thermo fluids, Aerodynamics, Convection Heat Transfer (Forced, Free, and Mixed), Porous Media and Metal Foams (Flow and Heat Transfer), Electronic Equipments Cooling, Heat Transfer in Manufacturing Processes (Welding, Rolling, ... etc.), Inverse Conduction, Turbomachinery (Pumps, Turbines, and Compressors), Heat Exchangers, Jet Engines, Phase-Change Heat Transfer, Boundary Layer (Hydrodynamic and Thermal). Supervising 38 M.Sc. Theses and 17 Ph.D. Dissertations.



**Prof. Dr. Hussain Yousif Mahmood Al-Hussainy:** B.Sc., M.Sc., & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Professor of Mechanical Engineering – Thermo fluids, Fluid mechanics, Heat transfer.





**Prof. Dr. Adnan Naji Jameel Al-Tamimi:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Mosul, M.Sc., & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. University of Aston in , Birmingham/ UK, Professor of Mechanical Engineering – Applied Mechanics, Detection of the damage location in large structures using natural frequency, Static and dynamic analysis by using FEM, Fracture mechanics, Vibration of shells, Dynamic stress, Elasto – plastic behavior of gun barrel, Design of gears, turbine blades, Dynamic analysis of composite laminated plates, Buckling, Stress analysis of biomechanical components, Fatigue, response, model analysis.



**Prof. Dr. Mohammad Qasim Abdullah:** B.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, M.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Al-Nahrin, & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Professor of Mechanical Engineering – Applied Mechanics, Applied Mechanics, Machine Design, Gear Design, Stress Analysis.



**Prof. Dr. Saad M. Saleh:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, M.Sc. in Mechanical Engineering Manchester University / UK, & Ph.D. in Mechanical Engineering / University of Technology, Professor of Mechanical Engineering – Thermo fluids, Solar Energy, Renewable Energy, Porous Media/Flow and Heat Transfer, Forced, Free & Combined Convection Heat Transfer, Combustion, Desalination, Power Plant Technology. Heat Transfer.



**Asst. Prof. Dr. Hatem R. Wasmi:** B.Sc. 1975 in Mechanical Engineering, Mech. Engr. Dept. – University of Mosul, M.Sc. 1977 & Ph.D. 1997 in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Asst. Prof. of Mechanical Engineering – Vibrations, Composite Materials, Fracture and Fatigue Mechanics, Plates and Shells, Stress Analysis, Elasticity, Plasticity, Structural Analysis, CAD, Biomedical Engineering, Smart Structures.



**Asst. Prof. Dr. Hussein S. Ketan:** B.Sc. in Mechanical Engineering/ University of Technology & M.Sc. & Ph.D. in industrial Engineering- Prod .Eng. Dep. University of Technology, Baghdad, Asst. Prof. of Industrial Engineering – Manufacturing Eng., Industrial Eng., Production Planning & Control – Quality Control , Total Q. Management , ISO , Operation Research, Artificial Intelligence (AI) , Intelligent Manufacturing System (IMS) , Engineering Statistics , CAD /CAM Process Planning (CAPP).



**Asst. Prof. Dr. Ali Abdul Mohsin Hasan Al-Asadi:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. /University of Technology, M.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – School of Mechanical Engineering / University of Cranfield/ England, Assistant Professor of Mechanical Engineering – Thermo fluids, Hydraulic Systems Control and Design, Fluids System and Components, Aerodynamics, Pumps Design, Cavitation in Pumps, Valves and Other Components.



**Asst. Prof. Dr. Manal H. Al-Hafidh:** M.Sc., & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Assistant Professor of Mechanical Engineering – Thermo fluids, Jet Propulsion, Porous Media/Flow and Heat Transfer, Air Pollution, Forced, Free & Combined Convection Heat Transfer, The Effect of Vibration on Heat Transfer, The Effect of Magnetohydrodynamic on Convection Heat Transfer, Wind Energy, Flow in a Can Type Combustor, Heat exchanger, Composite walls, Nanofluids, Noise Effect in Centrifugal Fan Impeller, Dusty air.



**Asst. Prof. Dr. Kareema E. Amori:** M.Sc., & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Asst. Professor of Mechanical Engineering – Thermo fluids, Aerodynamics, Solar and Renewable Energy, Nanofluid Mechanics, Heat Transfer and Fluid Dynamics, Computational Fluid Dynamics CFD, Boiling and Condensation, Thermal Analysis for Manufacturing Process.



**Asst. Prof. Dr. Soroor K. H. Al-Khafaji:** B.Sc. & M.Sc. in Electrical Engineering,. – College of Engr. / University of Technology, & Ph.D. in Industrial Engineering - College of Engr. / University of Baghdad, Assistant Professor of Mechanical Engineering – Industrial, Statistical Quality Control and Reliability Engineering, Production Planning and Control of Industrial Systems, Expert Systems and Intelligent Control of Industrial Systems.



**Asst. Prof. Dr. Fathi Abdulsahib A Alhussein:** B.Sc., & M.Sc. in Mechanical Engineering, Mech. Engr. Dept. – University of Technology, Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Asst. Prof. of Mechanical Engineering – Composite Materials, Fracture and Fatigue Mechanics, Plates and Shells, Stress Analysis, Elasticity, Plasticity, Tribology.



**Asst. Prof. Dr. Ahmed Abdul Hussein Ali Al-Hillawi:** B.Sc. & M.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Saint Peters Burg Polytechnic University/ Department of Automatic Complexes, Russia, Assistant Professor of Mechanical Engineering – Applied Mechanics, Robot Design and Deflections, Contact of Rough Engineering Surfaces, Stress and Deflection in Air Craft Wing, Flutter and divergence in composite Wing, Aero Elasticity, Air Craft Structure, Elasticity, Plasticity, Vibration of Machines, Mechanical Control and Measurements, Contact Mechanics, Journal and ball bearing mechanics, Lubrication, Wear Analysis and Measurements.



**Asst. Prof. Dr. Nabil H. Hadi Al-Saady:** B.Sc. & M.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad & Ph.D. Mechanical Engineering / Mech. Engr. Dept. – University of Saint Peters Burg Polytechnic University/ Department of Automatic Complexes, Russia, Assistant Professor of Mechanical Engineering – Vibration Measurements, Crack and Damage Modeling and Detection, Kinematics and Dynamics of Machines, Mechatronics and Modeling of Multi Body System, Intelligent Control System, Mechanical Vibration and Control, Automation, Artificial Intelligence, Robotics, Composite Material, Machine Design, Experimental Stress Analysis, Interface Devices and Microcontroller, Sensors Circuits and Health Monitoring and Damage Assessments of Mechanical Structures.



**Asst. Prof. Dr. Akram Wahbi Ahmed Ezzat:** B.Sc., M.Sc., & Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Assistant Professor of Mechanical Engineering – Thermo Fluids, Fluid Mechanics, Heat Transfer (Free, Forced and Mixed Convection), Aerodynamics, Gas Dynamics, Jet Propulsion.



**Asst. Prof. Dr. Najim A. Jassim Al-Mosawe:** B.Sc.in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, M.Sc.in Mechanical Engineering / University of Technology,& Ph.D. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, Assistant Professor of Mechanical Engineering – Thermo Fluids, Air Conditioning & Refrigeration, Renewable Energy Technology, Two-Phase Flow & Heat Transfer, Flow & Heat Transfer in Porous Media Thermal Energy Storage Technology, Direct & Indirect Contact Cooling Towers, Indirect Contact Heat Exchangers, Chilled Ceiling Applications, HVAC in Clean Area, Solar Heating & Cooling of Buildings.



**Asst. Prof. Dr. Wedad Ibrahim Majeed:** B.Sc., M.Sc. & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Assistant Professor of Mechanical Engineering – Applied Mechanics, Stress Analysis Experimentally and Numerically, Free and Forced Vibration for Composite Materials, Fracture Mechanism, Biomechanics, Cold and Hot Working, Composites Mechanics, Structures (Plate and Shell) Dynamics (Free and Forced Vibration, Fatigue), Thermal (Cryogenic) and Static Analyses, Smart Materials and Biomechanics.



**Asst. Prof. Dr. Louay Sabah Yousuf:** B.Sc., M.Sc., & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Asst. Prof. of Mechanical Engineering – Analysis and Design of Control Systems, Cooling of Spur Gears Using Through Holes, Composite Materials, Fracture and Fatigue Mechanics, Plates and Shells, Structural Dynamic, Stress Analysis Using Elasticity and Plasticity Theories, Tribology.



**Asst. Prof. Dr. Majid H. Faidh-Allah:** M.Sc. in Mechanical Engineering / Mech. Engr. Dept. – University of Baghdad, & Ph.D. in Mechanical Engineering / Machine and Equipment Engr. Dept. – University of Technology, Assistant Professor of Mechanical Engineering – Applied Mechanics, Gears Types, Splines Shafts, Plates and Shells Composite Material, Vibration, Design of Robotics, Mechanics of Materials, Theory of Machines, Mechanism Links, Elasticity, Plasticity, Stress and Strain Analysis, Mechanical Properties of Material under Cryogenics, Behavior of Materials.



**Asst. Prof. Dr. Ahmed Abdulrasool Ahmed Al-Khafaji:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Machines & Equipments Engineering / University of Technology, M.Sc. & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Assistant Professor of Mechanical Engineering – Manufacturing and Industrial Engineering, Production Processes, Operation Research, Production Planning, Statistical Quality Control, Manufacturing Process (welding, casting,...etc.) ..



**Dr. Abbas A .Hussein:** B.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Basrah, M.Sc. in Dept. of Metallurgy, / University of Sheffield, Ph.D. in Dept. of Metallurgy / University of Leeds, Assistant Professor of Mechanical Engineering – Heat treatment of steel (Quench Hardening, Dual Phase steel, Baking ), Microstructure of Steel ( Using Light Microscope, Transmission and Scanning Electron Microscope), Phases Isolation and identification (Using Replica techniques, Potentiostat Etching , X-Ray and Electron Diffraction) Thermo Chemical Treatment of Alloy Steel ( Nitriding), Mechanical testing (Tensile, Fatigue and wear).





**Lecturer Dr. Issam Mohammed Ali Al-jubury:** B.Sc., Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Al-Nahrain, M.Sc., Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Ph.D., Mechanical Engineering, Mech. Engr. Dept. – College of Russia. / University of SRSTU, Lecturer of Mechanical Engineering – Fluid Mechanics, Aerodynamics, Gas Dynamics, Jet Propulsion, Air conditioning.



**Lecturer Dr. Ibtihal Abbas Saddiq Abdulrida Faid Allah:** B.Sc., M.Sc. & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad, Lecturer of Mechanical Engineering – Applied Mechanics, Stress Analysis Experimentally and Numerically, Free and Forced Vibration for Composite Materials, Fracture Mechanism, Biomechanics, Cold and Hot Working.



**Lecturer Dr. Mohsin Abdullah A. Al-Shamari:** B.Sc. & M.Sc. in Mechanical Engineering, Mech. Engr. Dept. – College of Engr. / University of Baghdad & Ph.D. in Mechanical Engineering, Mech. Engr. Dept. / University of Technology, Lecturer of Mechanical Engineering – Applied Mechanics, Tribology, Vibrations, Plates and Shells, Automatic Control Engineering.



## 8. Samples of M.Sc. Theses and Ph.D. Dissertations

The following table shows samples of M.Sc. Theses and Ph.D. Dissertations of the department in the last 5 years.

No.	Year	Supervisor (s)	Title of Thesis or Dissertation	Name of Student	Degree	Specialty
1	2014	Prof.Dr.Qasim M. Doos & Assist.Prof.Dr.Soroo K.Hussien	Casting Process Improvements Based On Six Sigma With Simulation Modeling	Raed Mohsin Jodi	Ph.D.	Industrial Engineering
2	2014	Assist. Prof. Dr. Ali Abdul Al Muhsen Al-Asady	Fluidic Jet Vectoring At Subsonic Flow By Using A Counter Flow Method	Omar Hussien Ali	M.Sc.	Thermo-Fluids
3	2014	Prof.Dr.Qasim M. Doos & Instruc. Dr.Abdulkareem Ali M.	Designing And Characterization Of Honeycomb Nano Porous Alumina Filter Systems	Hasan Abdul Kadhim Abbas	M.Sc.	Manufacturing Engineering
4	2014	Dr.Abbas Abdul Hussein Abid	Effect Of Bake Hardening On Mechanical Properties And Microstructure Of Resistance Spot Welded Low Carbon Dual Phase Steel	Abbas Fadil Abbas	M.Sc.	Engineering Materials
5	2013	Assist.Prof.Dr.Zuhair Issa Ahmed Al-Daood	Implementation Of Lean Principles In Material Handling And Storage In Ink Factory	Raghad Abd Uljaleel Abd Ulkareem	M.Sc.	Industrial Engineering
6	2013	Assist.Prof.Dr.Ahmed Abdulrasool Ahmed Asst.Prof.Dr.Zuhair Issa Ahmed	Computer Aided Scheduling Optimization Through Altering Factory Layout	Falah Hassan Abdulsada	M.Sc.	Industrial Engineering
7	2013	Assist.Prof.Dr.krawm.Ahmed Ezzat	Thermal Analysis Of Immersed Heat Source During Flow Reduction Transient	Salah Isam Hasan	M.Sc.	Thermo-Fluids
8	2013	Assist.Prof.Dr.Ali A.Hasan Assist.Prof.Dr.krawm.Ahmed Ezzat	Investigation Of Steam Condensation On Rotating Disc	Ayser Muneer Al-Obaidee	Ph.D.	Thermo-Fluids

9	2013	Assist.Prof.Dr.Kari maesmail Amori	Prediction Of Thermal Character- Istic Of Nanofluid Based Novel Hybrid Of Photovoltaic/ Thermal Solar Collector	Qasim Kadhim Hunehen	Ph.D.	Thermo-Fluids
10	2013	Asst.Prof.Dr.Hate m R.Wasmi Dr.Ibtihal Abbas Sadiq	Non-Linear Analysis Of Laminated Plate Under General Out-Of- Plane Loading	Muhsson Asfoor Laftah	M.Sc.	Applied Mechanics
11	2013	Asst.Prof.Dr.Hate m R.Wasmi Asst.Prof.Dr.Juma a S.Chiad	Numerical And Experimental Study Of Prosthetic Above Knee Socket Under Fatigue Stress And Varying Temperatures Effect	Adawiya Ali Hamzah	M.Sc.	Applied Mechanics
12	2013	Prof. Dr.Adnan Naji Jameel Lect.Dr.Louay Sabah Yousuf	Buckling Of Stiffened And Un Stiffened Laminated Composite Plates Under Combined Loading	Ahmed Mahdi Salih	M.Sc.	Applied Mechanics
13	2013	Dr.Fathi Al- Mshamaa	The Effect Of Dynamic Plasticity On The Crack Propagation In Thin Plates Subjected To Impact Loading	Muthenna Abdul Hussein Ali Owayez	M.Sc.	Applied Mechanics
14	2013	Prof. Dr. Ihsan Y. Hussain	Mixed And Natural Convection In Confined Porous Medium With Uniform And Periodic Boundary Conditions	Luma Fadhil Ali	Ph.D.	Thermo-Fluids
15	2013	Assist.Prof.Drakra mw.Ahmed Ezzat	Thermo-Hydraulic Behavuur Of Water Cooling Channel Subjected To Constant Heat Flux During Transient Pressure Reduction	Emad Whhaib Nayyef	M.Sc.	Thermo-Fluids
16	2013	Assist .Prof .Dr.Karima Esmail Amori	Experimental And Numerical Analysis Incompressible Flow Over An Iced Airfoil	Ethar S. Ahmed	M.Sc.	Thermo-Fluids
17	2013	Prof. Dr.Khalid A.Joudi	Solar Assisted Desiccant System For Air-Conditioning Greenhouse In Baghdad	Ammar Ali Farhan	Ph.D.	Thermo-Fluids
18	2013	Assist.Prof.Dr.Ah medabdul Hussain Ali	The Effect Of Dynamic Loading On Stresses Induced In Hip Joint Prosthesis	Mahmood Wael Said	M.Sc.	Applied Mechanics
19	2013	Dr. Akram W.Ezzat	Forced Convection Heat Transfer Around Heated Inclined Cylinder	Hassan Waleed Zghier	M.Sc.	Thermo-Fluids



20	2013	Assist.Prof.Dr.Hatem R.Wasmi	Investigation Of Hole Size Effect On Strength Of Laminated Sandwich Beams And Plates	Nawalfalkhous Eshaut	M.Sc.	Applied Mechanics
21	2013	Assist .Prof.Dr.Ali Al-Asady	Thrust Vectoring Of Fluid Jet Using Secondary Co-Flow	Ahmed Mujahid Abdullah	M.Sc.	Thermo-Fluids
22	2013	Assist.Prof.Dr.Najim A.Jassim	An Investigation Into Thermal Performance Of Mist Water System And The Related Consumption Energy	Firas Adel Abdul Kareem Haris	M.Sc.	Thermo-Fluids
23	2013	Prof. Dr.Najat N.Abdlla Assit.Prof.Dr.Ikhla se M.Fayed	Effect Of End Wall V-Riblets O The Drag And Heat Transfer Rates In Gas Turbine Cascade	Kareem Khalaf Ali	Ph.D.	Thermo-Fluids
24	2013	Prof. Dr.Qasim M.Doos Al-Attaby Assit.Prof.Dr.Tahs eenf.Abaas	The Effect Of Tool Geometry And Path Strategy In Single Point Incremental Forming	Aqeel Sabree Bedan Al-Tamimi	Ph.D.	Manufacturing Engineering
25	2013	Prof. Dr.Khalid A.Joudi	Experimental Assessment And Numerical Simulation Of The Performance Residential Air- Conditioning Systems Using Alternative Refrigerants To R-22 At High Ambient	Qusay Rasheed Abid Al- Amir	Ph.D.	Thermo-Fluids
26	2013	Asist .Prof.Dr.Manal H.Saleh Assist .Prof.Dr.Muna S.Kassim	Experimental And Theoretical Investigation Of Design Parameters Effect On Peressure Level In Centrifugal Blower	Amina H. Hnaef	M.Sc.	Thermo-Fluids
27	2013	Prof. Dr.Adnan Najj Jameel	Vibration Analysis Of Laminated Composite Plate Under Thermo-Mechanical Loading	Rasha Mohmmmed Hussein	M.Sc.	Applied Mechanics
28	2013	Prof.Dr.Muhsin J.Jweeg Dr.Mohsin A.Abdulhussein	Theoretical And Experimental Investigations Of Creep And Buckling Effects On Composite Columns	Bashar Kassim Zalzala	M.Sc.	Applied Mechanics
29	2013	Assist .Prof.Dr.Ali Abdul Mohsin Al-Asadi	Experimental And Theoretical Study On Cavitation Effects In Centrifugal Pumps	Nabeel Ahmed Kamal	M.Sc.	Thermo-Fluids

30	2013	Prof. Dr. Ihsan Y. Hussain	Experimental And Numerical Investigation Of Forced Convection In A Porous Medium Subjected to Constant Heat Flux	Aya Adnan Yaseen	M.Sc.	Thermo-Fluids
31	2013	Assist.Prof.Manalh .Al-Hafidh	Laminar Free Convection In Horizontal Annulus Filled With Glass Beads And With Fins On The Inner Cylinder	Ahmed Mohsen Katea	M.Sc.	Thermo-Fluids
32	2013	Prof. Dr Najdat Nashat Abdulla Prof. Dr Adnan Naji Jamel	Effect Of Design Parameters And Support Conditions On Vibration In A pipe Conveying Fluid	Wijdan Kadhim Sahib	Ph.D.	Thermo-Fluids
33	2013	Prof. Dr.Saad M.Saleh	Parametric Study Of Active Solar Heater Using A pebble Bed As Thermal Collector And Storage	Mustafa Mahdi Mustafa	M.Sc.	Thermo-Fluids
34	2013	Prof. Dr. Ihsan Y. Hussain	Investigation Of Natural Convection In Inclined Cylindrical Enclosure Porous Media Subjected To Constant And Period Heat Flux	Nasr Abdul-Ameer Jabbar Al-Khalidy	M.Sc.	Thermo-Fluids
35	2013	Prof. Dr. Ihsan Y. Hussain	Investigation Of Natural Convection Heat Transfer From A plane Wall To A thermally Stratified Porous Media	Basim Kalid Raheem Al Qarloosy	M.Sc.	Thermo-Fluids
36	2012	Prof. Dr.Eng.Ihsan Y. Hussain	An Investigation Of Gear Pump Performance With Unsymmetrical Teeth Profile	Hussein Jabbar Hussien	Ph.D.	Thermo-Fluids
37	2012	Prof. Dr. Muhsin J. Jweeg	Enhancement Of Gear Drive Performance Using An Alternative Design Approach Of Teeth Profiles	Mohammad Qasim	Ph.D.	Applied Mechanics
38	2012	Asst.Prof.Dr.Ahmed A.Al-Hussein Ali	Investigation Of Abrasive Wear In The Pipes Used For Oil Industry	Mohanad Kassim Zalzala	M.Sc.	Applied Mechanics
39	2012	Prof. Dr.Khalid A. Joudi	Analytical Appraisal And Experimental Verification Of The Ashare Cooling Load Calculation Methods For A Hot Arid Climate	Ali Naser Hussien Al-Joboory	Ph.D.	Thermo-Fluids
40	2012	Assist .Prof .Dr.Karima Esmail Amori	Thermal Performance Of Finned And Unfinned Evacuated Tube Heat Pipe	Mohanad Lateef Abdullah	Ph.D.	Thermo-Fluids

41	2012	Asst. Prof .Dr .Saad M.Saleh Prof .Dr.Qasim S.Mahdi	Experimental And Theoretical Study Of Natural Draft Wet Cooling Tower Performance	Basima Salman Khalaf	Ph.D.	Thermo-Fluids
42	2012	Asst. Prof .Dr .Saad M.Saleh Al- Mashaat	Evaluation Of Convection Heat Transfer And Natural Circulation In An Evacuated Tube Solar Collector	Abbas Ahmed Hasan	M.Sc.	Thermo-Fluids
43	2012	Dr.Fathi Al- Mshamaa Dr.Amar Sabih Al- Allaq	Experimental And Modeling Study Of Abrasive Wear Of Tungsten Carbide Drilling Bit In Wet And Dry Conditions	Mohaimen Habeeb Mekki	M.Sc.	Applied Mechanics
44	2012	Prof .Dr. Ihsan Y.Hussain	Mixed Convection With Phase Change In Cylindrical Enclosure Of Porous Media	Mohammed Abdulraouf Nima Al-Safi	Ph.D.	Thermo-Fluids
45	2012	Prof. Dr.Najdat N.Abdullah Ass..Prof.Dr.Moha mmad H.Hafiz	Experimental And Theoretical Investigation Of Optimal Control On Flow Rate And Temperature Of Electrolyte For An Electrochemical Machining System	Raad Muzahem Fenjan	Ph.D.	Thermo-Fluids
46	2012	Asst. Prof .Dr .Saad M.Saleh Al- Mashaat	Performance Evaluation Of Solar Desalination Under Baghdad Climatic Condition	Raed F.Abdul Lateef	M.Sc.	Thermo-Fluids
47	2012	Prof .Dr. Ihsan Y.Hussain Asst .Prof .Dr.Karima E.Amori	Numerical And Experimental Study Of Enhancement Of Heat Transfer Rate By Using Oscillating Fin	Dheya Ghanim Mutasher	Ph.D.	Thermo-Fluids
48	2012	Dr .Nabil Hassan Hadi	Genetic Algorithm Based Optimal Robotic Manipulator Design	Marwa Qasim Ibraheem	M.Sc.	Applied Mechanics
49	2012	Assist .Prof .Dr.Karima Esmail Amori	Numerical Study Of Convective Heat Transfer In An Enclosure Utilizing Nanofluid Using Fluent	Maher Mahmoud Hussein	M.Sc.	Thermo-Fluids
50	2012	Prof .Dr.Moneer H.Tolephih Prof.Dr.Qasim M..Doos	Experimental And Numerical Investigation To Improve The Strength Of Resistance Spot Weldment By Metallic Powder Additives For Aa1050sheet	Ihsan Kadhom Al- Naimi	Ph.D.	Manufacturing Engineering

51	2012	Assist .Prof .Dr.Karima Esmail Amori	An Investigation Of Heat Transfer And Hydrodynamic Characteristics Of New Helical Coiled Tube Used In Solar Water Heating System	Jinan Shaker Sherza	M.Sc.	Thermo-Fluids
52	2012	Asst .Prof .Dr.Saad. M. Saleh Al –Mashat	Evaluation Of Convective Heat Transfer And Natural Circulation In An Evacuate D Tube Solar Collector	Abbas Ahmed Hasan	M.Sc.	Thermo-Fluids
53	2012	Ass.Prof.Dr.Soroor K. Hussain	Construction And Monitoring Failure For Diagnosis Equipment System For Reliability Assessment Using Fuzzy Logic Approach	Manal Mohamed Abed	M.Sc.	Industrial Engineering
54	2012	Prof.Dr.Qasim M..Doos	Experimental Study Of Friction Stir Welding Of 6060-T6 Aluminum Pipe	Bashar Abdul Wahab	M.Sc.	Applied Mechanics
55	2012	<b>Ass.Prof. Dr.Akram W.Ahmed Ezzat</b>	Experimental Study Of Power Increase Transient In Heat Generation Systems Simulated By Immersed Heat Source	Sarmad Aziz Abdul Hussain Al Sarraf	M.Sc.	Thermo-Fluids
56	2012	Asst.Prof.Dr.Fathi A. Alshamaa	A Study Of Stress Distribution And Crack Growth In Spline Shaft Subjected To Cyclic Impulsive Load	Hawaa Falih Kadhim Al Salihi	M.Sc.	Applied Mechanics
57	2012	Dr .Widad I .Majeed Dr .Shibly Ahmed Al-Samarraie	Analysis Of Vibration Control Of Beam Using Smart Material	Mohanad Mowafahk Nasser	M.Sc.	Applied Mechanics
58	2012	Dr.Abbas A. Hussein	Study The Effect Of Cryogenic Treatment On The Mechanical Properties Of Dual Phase Steel	Hussein Burhan Muhammad	M.Sc.	Engineering Materials
59	2012	Prof.Dr.Adnan Naji Jameel	Buckling Behavior Of Damaged Composite Plates	Kawther Khalid Younus	M.Sc.	Applied Mechanics
60	2012	Ass. Prof .Ali .Al- Al-Assady	Design And Analysis Of Electro –Hydraulic Closed Loop System For Speed Control Of Hydraulic Motor Using Proportional Valve	Mohammed Talib Jassim Al –Khafaji	M.Sc.	Thermo-Fluids

61	2012	Ass.Prof.Dr.Soroor K. Hussain	Simulation Model Design For Lean Manufacturing System To Improve Productivity	Header Mahmood Rah- Ema	M.Sc.	Industrial Engineering
62	2011	Prof .Dr. Adnan Naji Jameel	Buckling Analysis Of Composite Plates Under Thermal And Mechanical Loading	Hasanain Ibraheem Nsaif	M.Sc.	Applied Mechanics
63	2011	Prof.Dr. Najdat N. Abdulla	Effect Of Wall Elasticity On The Flow Field Through Stenosis Arteries And Veins	Noor Muhsin Farhan	M.Sc.	Thermo-Fluids
64	2011	Dr.Abbas A.Hussein	Effect Of Cryogenic Treatment On Properties Of Some Carbon And Alloy Steels	Murtadha Qasim Idan Al -Kinani	M.Sc.	Engineering Materials
65	2011	Asst .Prof .Dr.Saad. M.Saleh	Parametric Study Of Laminar Inclind Porous Annulus With Fins Of The Inner Cylinder	Manal Hadi Al-Hafidh	Ph.D.	Thermo-Fluids
66	2011	Dr. Nabil H. Hadi	Cenetic Algorithms For Damage Detection Of Composite Structures	Kayser Aziz Ameen	Ph.D.	Applied Mechanics
67	2011	Ass.Prof. Dr.Akram W. Ezzat	Water Flow Visualization And Velocity Measurement Using Hydrogen Bubble Generation Technique In Low Speed Open Channel	Taif Majeed Mansoor	M.Sc.	Thermo-Fluids
68	2011	Prof.Dr.Qasim M..Doos Dr..Abdulkareem M. Ali Al- Sammarraie	Anodic Oxide Template Synthesis And Characterization Of Nanostructure By Electrodeposition	Yousif Raheem Mohammed	M.Sc.	Manufacturing Engineering
69	2011	Ass.Prof.Dr.Fathi Abd Al-Saheb Al- Shamma	The Effect Of Cycling Impact Loading On Dvnamic Crack Propagation On Curved Plate	Marwa Abd- Alwahab Hameed	M.Sc.	Applied Mechanics
70	2011	Asst. Prof.Dr. Ali Abdul Almuhsen Al-Asady	Desgin And Implimentaion Of Fludics Oscillator	Bahaa Aldeen M. Razouqi	M.Sc.	Thermo-Fluids
71	2011	Prof.Dr. Qasim M. Doos	Experimental Investigation Of Tee-Section Welding Using Friction Stir Welding Process Of Aluminum	Kamaal Sahib Makki	M.Sc.	Manufacturing Engineering

72	2011	Asst. Prof.Dr.. Karima E. Amori	Performance Analysis Of Avirous Conceptual Desgin For The Air Based Photovoltaic Thermal Collectors	Moustafa Adil Abdulrahem Aldamook	M.Sc.	Thermo-Fluids
73	2011	Asst. Prof.Dr. Nabil Hassan Hadi	Damage Detection Of Composite Laminated Beams Using Genetic Algorithm	Ahmed Amer Alkarkhy	M.Sc.	Applied Mechanics
74	2011	Asst. Prof. Dr. Ahmed A. Ali	The Effect Of Laminated Layers On The Flutter Speed Of Composite Wing	Mohammed Ismael Hamed	M.Sc.	Applied Mechanics
75	2011	Prof. Dr. Ihsan Y. Hussain	Experimental And Numerical Investigation Of Natural Convection Heat Transfer From Aplane Wall To Athermally Stratified Environment	Naseem Kamil Ali Al Okaili	M.Sc.	Thermo-Fluids
76	2011	Dr.Najim Abid Jassim	An Investigation Into Thermal Performance Of An Indirect Contact Closed Type Cooling Tower	Mohammed Abd Al- Khaliq Al- Tayyar	M.Sc.	Thermo-Fluids
77	2011	Prof . Dr. Khalid A. Joudi	Evaluation Of A Solar Assisted Desiccant Cooling System For A Small Meeting Hall	Hussam Hikmat Jabbar	M.Sc.	Thermo-Fluids
78	2011	Prof . Dr. Qasim M . Doos	Study Of The Friction Stir Welding On Low Carbon Steel	Riyadh Fara Farhan Al- Attabi	M.Sc.	Manufacturing Engineering
79	2011	Prof. Dr . Ihsan Y .Hussain Dr. Najim A. Jasim	An Investigation Into Three Phase Direct-Contact Heat Tranfer With Gas Hydrate (Phd)	Bassim Kadum Abbas	Ph.D.	Thermo-Fluids
80	2011	Asst . Prof .Dr .Soroor K. Hussein	Using Universil Material Tester To Study Effect Of The Porosity On Wear Behavior	Ameer Hussein Ali	M.Sc.	Industrial Engineering
81	2011	Prof .D R. Adnan N. Jameel	Generation And Simulation Of Teeth Meshing With Numerical Experimental Stress Analysis For Straight Bevel Gear Drives	Mazin Jassim Oheil	M.Sc.	Applied Mechanics

82	2010	Prof. Dr . Ihsan Y .Hussain	Experimental And Theoretical Study Of Natural Convection With Phase Change In Confined Porous Media	Ayad K.Hassan	Ph.D.	Thermo-Fluids
83	2010	Ass.Prof. Mohammad Q. Abdullah	Simulation And Development Of Teeth Meshing Cycle Of The Gear Pump	Mustafa Ayad Mudhehere	M.Sc.	Applied Mechanics
84	2010	Prof . Dr .Khalid A . Joudi	Simulation Of Heat Storage And Heat Regeneration In Phase Change Material	Ahmed Kasim Taha	M.Sc.	Thermo-Fluids
85	2010	Asst.Prof.Dr. Adnan .N .Jameel Dr..Wedad I.Wajeed	Stress Analysis Of Prosthesis	Alaa Mohammed Razzaq	M.Sc.	Applied Mechanics
86	2010	Assit. Prof .Dr Ahmed A .Ali	The Stataic Analysis Of Comosite Aircraft Wing Box Structure	Azhar K . Farhood	M.Sc.	Applied Mechanics
87	2010	Dr.Hussain Abed Ali Alrobaei	Evaluation Of The Performance Of Solar Photovoltaic \Thermal System In Residential Buildings	Fadul Abdul Ameer Sajit	M.Sc.	Thermo-Fluids
88	2010	Ass.Prof. Dr.Karima E.Amori	Thermal Analysis And Perfrence Of Electrical Metal Foam Heater	Hussein Alwan Laibi	M.Sc.	Thermo-Fluids
89	2010	Dr. Majid H.Faidh _Allah	Experimental And Numerical Investigation Of Stresses In Partially Splined Shaft	Zainab Amjed Abdul Khalik	M.Sc.	Applied Mechanics
90	2010	Ass.Prof. Dr.Karima E.Amori	Experimental And Numerical Study Of Solar Chimney For Ventilation	Saif Watheq Mohammed Ali	M.Sc.	Thermo-Fluids
91	2010	Prof. Dr. Adnan Naji Jameel	Parametric Study Of An Oil Belt Skimmer Using Genetic Algorithms Technique	Hassneen Qasem Hassan	M.Sc.	Applied Mechanics
92	2009	Prof. Dr. Qasim M. Doos Prof. Dr. Muhsin Jabir Jweeg	An Investigation Of Friction Stir Welding And Stress Relieve By Vibration Of 6061t6 Aluminum Alloy	Sarmad Dhia Ridha Al-Bayaty	Ph.D.	Applied Mechanics



93	2009	Prof .Dr. Khalid A.Joudi	Performance Analysis Of Atwo _Phase Solar Hot Water System With Combined Sensible And Latent Heat Storage	Aouf Abdulrahman Ahmed Al_Tabbakh	Ph.D.	Thermo-Fluids
94	2009	Ass.Prof .Dr. Fathi A.S Al_Shamaa	The Effect Of Low Velocity Impact Loading In A Laminated Orthotropic Helical Spring	Mohammed Badral Tawfik	Ph.D.	Applied Mechanics
95	2009	Prof.Dr. Khalid A. Joudi	Experimental Investigation Of Evacuated Tube Heat Pipe Solar Heating Systems	Hassan Najji Salman Al-Joboory	Ph.D.	Thermo-Fluids
96	2009	Ass.Prof .Dr. Fathi A.S Al_Shamaa	A Study Of Delamination Problem In A Leaf Spring Made Of Composite Material Under Impact Load	Ali Mohammed Ali	M.Sc.	Applied Mechanics
97	2009	Ass. Prof .Dr .Saad M.Saleh	Thermal Performance Of Evacuted Tube Solar Heating System	Hamza Jabbar Hammad	M.Sc.	Thermo-Fluids
98	2009	Prof .Dr. Ali Abdul Almuhsin Al_Asady	Design And Analysis Of Fluidics Vortex Rate Sensor	Wisam	M.Sc.	Thermo-Fluids
99	2009	Ass.Prof.Dr. Ahmed A. Ali	Effect Of Aerodynamic Characteristics On The Surface Damage Of A Composite Wing Structure	Samara M. Naem	M.Sc.	Applied Mechanics
100	2009	Ass.Prof. Manal H. Saleh	An Investigation Of Fins Geometry Effects For Laminar Free Convection In Horizontal	Harith Hussein Hamza	M.Sc.	Thermo-Fluids
101	2009	Prof . Hussain Yousif Mahmood	Investigation Of Fogging System And Its Effect On Power Generation Of Gas Stations	Adel Badir Abdulhussain Alriyahi	M.Sc.	Thermo-Fluids
102	2009	Ass.Prof. Fathi A. Al-Shamaa	An Analysis Of Cracks In Simply Supported Curved Plates Under Combined Buckling & Impact Loading	Jasim Hasan Ilik	M.Sc.	Applied Mechanics

103	2009	Ass.Prof. Mohammad Q. Abdullah	Simulation Of Meshing & Contact With Stress Analysis Of Hypoid Gear Drive	Nassear Rasheid Hmoad	M.Sc.	Applied Mechanics
104	2009	Dr. Nabil Hassan Hadi	Damage Detection & Assessment In Mechanical Beams Using Genetic Algorithm	Aveen Ahmed	M.Sc.	Applied Mechanics
105	2009	Dr. Ihsan Y. Hussain	Experimental & Computational Investigation Of Developing Laminar Mixed Convection Through Concentric Annuli With Asymmetric Heating	Najim Abed Kadhum	M.Sc.	Thermo-Fluids
106	2009	Prof.Dr. Muhsin J. Jweeg	Dynamic Response Of Composite Plates Under Cryogenic Environment	Ebtihal Abbas Sadiq	M.Sc.	Applied Mechanics
107	2009	Dr. Ihsan Y. Hussain	Developing Laminar Mixed Convection Heat Transfer Through Concentric Annuli With Adiabtic Inner Cylinder	Ghada Abbas Sadiq	M.Sc.	Thermo-Fluids
108	2009	Ass.Prof. Manal Hadi Al-Hafidh	Mixed Convective & Radiative Heat Transfer In An Inclined Concentric & Eccentric Cylindrical Annuli	Lina Sinan Safwat	M.Sc.	Thermo-Fluids
109	2009	Prof. Dr. Qasim M. Doos	The Influence Of Tool Geometry Of Friction Stir Weld On Mechanical Properties And Microstructure Of 2218-T72 Aluminum Alloy	Samer Jasim Al-Joudi	M.Sc.	Manufacturing Engineering
110	2009	Ass.Prof. Manal Hadi Al-Hafidh	Magneto Hydrodynamic Natural Convection Flow On A Vertical Cylinder With A Presence Of Heat Generation And Radiation	Methaq Talib Ali	M.Sc.	Thermo-Fluids
111	2009	Dr. Majid H. Faidh-Allah	Layer Optimization Of Laminated Hybrid Composite Simply Supported Plates	Musaddiq Abdil Khaliq Malih	M.Sc.	Applied Mechanics