Mnistry of Hgher Education and Scientific Research

UNIVERSITY OF ANBAR

COLLEGE OF ENGINEERING

MECHANICAL ENGINEERING DEPARTMENT

MECHANICAL ENGINEERING DEPARTMENT
COLLAGE OF ENGINEERING - UNIVERSITY OF ANBAR

UNDERGRADUAT

HANDBOOK

Preface

This Mechanical Engineering (ME) handbook is prepared to orient and guide students through their ME educational experience. It serves the students who intend to obtain a Bachelor of Science degree in Mechanical Engineering. It helps them as entering and continuing their ME undergraduate studies in the College of Engineering at the University of Anbar. It has been written and prepared to be a reference guide to the undergraduate ME program requirements with the college and university requirements. The curriculum of each course has been prepared to cover all materials that are required We hope that it will provide them with all the information that they need about the ME major.

Also, the curriculum has been prepared to ensure that the Mechanical Engineering program demonstrates that the students attain the National Graduate Outcomes (NGO's). The Mechanical Engineering Department (MED) would also like to spotlight and emphasize the real importance of the ethical and social implications of the work of ME engineers as a contribution to the development and improvement of society. All MED faculty members hope that you find this MED handbook a useful resource during your years at MED and wish you all success.

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Vision

The Department of Mechanical Engineering endeavours to be one of the leading Mechanical Engineering Programs in Iraq and the Arab world.

Mission

The Department of Mechanical Engineering's mission is to educate, prepare, encourage, and advise students in order for them to excel as professionals and to provide graduates with advanced knowledge and skills as well as high quality engineering education.

Objectives

Based on the missions of the University of Anbar and the College of Engineering, the following educational objectives for the BSc program in Mechanical Engineering were developed. Within a few years of graduation, our graduates will be able to:

1) Use science, mathematics, computational thinking, and mechanical engineering ideas, such as design theory, experimental techniques, and production, to solve practical problems.
2) Use strong critical thinking, innovation, and problem-solving skills in order to pursue a successful career.
3) Use effective communication skills and participate in multi-disciplinary partnerships to demonstrate professional progress and leadership.
4) The graduate will work independent and in multidisciplinary teams to efficiently attain personal and organizational objectives, participate in community or public service, produce a product or construction that meets a social need, and/or contribute in teaching persons about a societal issue.
5) Engage in life-long learning and career growth while maintaining professional and ethical standards.

Mechanical Engineering Program

The Mechanical Engineering department expands the frontier of human knowledge in the discipline of mechanical engineering through fundamental and applied research conducted by faculty and students. It applies the principles of

mechanical engineering to bear on important problems of national and regional, implication: mechanical design, thermal sciences and production. The outcomes for the Mechanical Engineering Program were chosen so that the ME graduates will be prepared to meet the program objectives. Thus, graduates of the Mechanical Engineering Program will have:

1. The ability to apply knowledge of mathematics, science, and engineering to design and conduct experiments, as well as to analyze and interpret data;
2. The ability to identify, formulate, solve engineering problems or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
3. To understand the impact of engineering solutions in a global, economic, environmental, and societal context.
4. The ability to communicate effectively and engage in life-long learning.
5. The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Accreditation

The Bachelor of Science in Mechanical Engineering degree offered by the MED is in good progress to be accredited by the Engineering Accreditation Commission of National Graduate Outcomes (NGO's).

Enrolment and Graduation Rates

Bachelor of Science in Mechanical Engineering Enrolment and Graduation Rates

Year	Enrolment	Degrees Awarded	Year	Enrolment	Degrees Awarded
1990-1989		-	2007-2006	44	32
1991-1990	145	-	2008-2007	75	33
1992-1991	60	-	2009-2008	53	15

1993-1992	80	27	2010-2009	76	12
1994-1993	70	35	2011-2010	56	30
1995-1994	104	38	2012-2011	67	28
1996-1995	120	35	2013-2012	78	34
1997-1996	139	46	2014-2013	83	42
1998-1997	130	46	2015-2014	67	34
1999-1998	98	35	2016-2015	65	53
2000-1999	115	55	2017-2016	64	26
2001-2000	144	51	2018-2017	54	32
2002-2001	176	54	2019-2018	93	31
2003-2002	148	90	2020-2019	78	45
2004-2003	117	80	2021-2020	122	30
2005-2004	51	89	2022-2021	43	
2006-2005	36	101			

Programme Educational Objectives (PEOs)

PEO-1: Professional Presence

As a result, within a few years, the graduate has established an Internet presence, either through professional organizations, social networking and/or other activities which demonstrate an appreciation and use of modern technological capabilities.

PEO-2: Workforce Skilled in Integrating Engineering, Design, and modern Technology

As a result, graduates will identify opportunities to contribute to develop society life from a variety of positions, ranging from design and produce modern devices, conducting the awareness program in minimizing the solid waste, in the safety aspects of our mundane activities, introducing the cost effective products, using the present technology in an environmental friendly way/approach and engage professionally in private and governmental sectors such as consulting firms, contracting companies, marketing and real-estate investments. The graduate may also pursue further education in the form of graduate and professional degrees.

PEO-3: Leadership in Research, Innovation and Design

As a result, within a few years of graduation, the graduate will have made significant or meaningful contributions in his or her chosen field, either thorough research publications and/or presentations, the development of a new design or conducting processes, obtaining patents, or other evidence of contributing to the advancement of knowledge, particularly in the fields of product design, fabrication/manufacture, energy and power.

PEO-4: Ethical Reasoning, Behaviour and Professionalism

As a result, within a few years of graduation, the graduate will demonstrate adherence to the professional codes of conduct appropriate to his or her field of study and/or practice, as well as exhibit behaviour consistent with accepted standards of fiduciary responsibility, risk/benefit analysis and professional accountability.

PEO-5: Communication

As a result, graduates will have outstanding communication skills as evidenced by their professional presentations, and in their productive interactions with co-workers. The graduates may also use their communication skills to foster collaborative effort among co-workers and/or may represent his or her company, institution and/or laboratory to other interested parties.

PEO-6: Personal Engagement

As a result, within a few years, the graduate will be working independently and in multidisciplinary teams to effectively and efficiently achieve personal and organizational goals, engage in community or public service, create a product or construction that fills a social need, and/or participate in educating individuals about an issue of societal concern.

Student Learning Outcomes (SLO's)

SLO-1: Technological Skills
The graduate makes appropriate use of technologies to communicate, collaborate, solve problems, make decisions, and conduct research, as well as foster creativity and life-long learning. The graduate is able to use state-of-the-art technological resources and tools and keeps up on advancements in her or her field of study and/or practice.

SLO-2: Problem Solving Abilities
The graduate is able to creatively solve problems from both analytic and applied perspectives using multiple approaches, integrating sciences, engineering, and the humanities. The graduate is able to recognize, incorporate and adapt to the limitations and consequences of applying various problem solutions.

SLO-3: Innovation and Design
The graduate often makes discussions and observations that lead to new ideas or hypotheses. He or she formulate novel solutions while moving beyond the conventional to new methods blending creative and practical approaches, constructions and designs which may involve pioneering applications along the interface of engineering and modern technology. The graduate has the ability to create highly sophisticated designs and implement them which are considered state-of-the-practice in his or her field.

SLO-4: Research Abilities
The graduate is able to collect and process data, information and knowledge to answer specific questions or generate new conceptual models and hypotheses. The graduate evaluates these models and hypotheses using the appropriate experimental, mathematical and statistical approaches.

SLO-5: Leadership
The graduate is able to articulate a vision or goal in such a manner as to promote collaboration and successful implementation. The graduate displays a willingness to overcome adversity and work diligently in pursuit of goals, thus serving as a role model for others.

SLO-6: Communication
The graduate employs an understanding of audience, purpose and context to communicate effectively in a range of situations using appropriate media while displaying a significant aptitude for presenting scientific and technical materials to diverse audiences.

SLO-7: Human Resources and Interactions
The graduate is able to work either independently or in diverse groups to effectively and efficiently to respond to academic and work requirements.

SLO-8: Engagement
The graduate uses his or her knowledge and skills, including those associated with engineering and applied science, to make a positive difference on issues of public concern.

SLO-9: Ethical Reasoning, Behaviour and Professionalism
The graduate recognizes ethical issues, considers multiple points of view, and uses critical ethical reasoning to determine the appropriate behaviour to follow. The graduate thus demonstrates a high level of integrity and a positive work ethic combined with a thorough understanding of the ethical implications and obligations associated with the practice of all the fields of mechanical engineering.

ABET Student Outcomes (SO's)

SO-1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO-2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO-3: An ability to communicate effectively with a range of audiences.
SO-4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO-5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO-6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
SO-7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Iraqi National Accreditation Criteria (ICAEE) National Graduate Outcomes (NGO's)

NGO-i: An ability to distinguish, identify, define, formulate, and solve engineering problems by applying principles of engineering, science and mathematics.

NGO-ii: An ability to produce engineering designs that meet desired needs within certain constraints by applying both analysis and synthesis in the design process.

NGO-iii: An ability to create and carry out proper measurement and tests with quality assurance, analyze and interpret results, and utilize engineering judgment to make inferences.

NGO-iv: An ability to skilfully communicate orally with a gathering of people and in writing with various managerial levels.

NGO-v: An ability to perceive ethical and professional responsibilities in engineering cases and make brilliant judgments taking into account the consequences in worldwide financial, ecological and societal considerations.

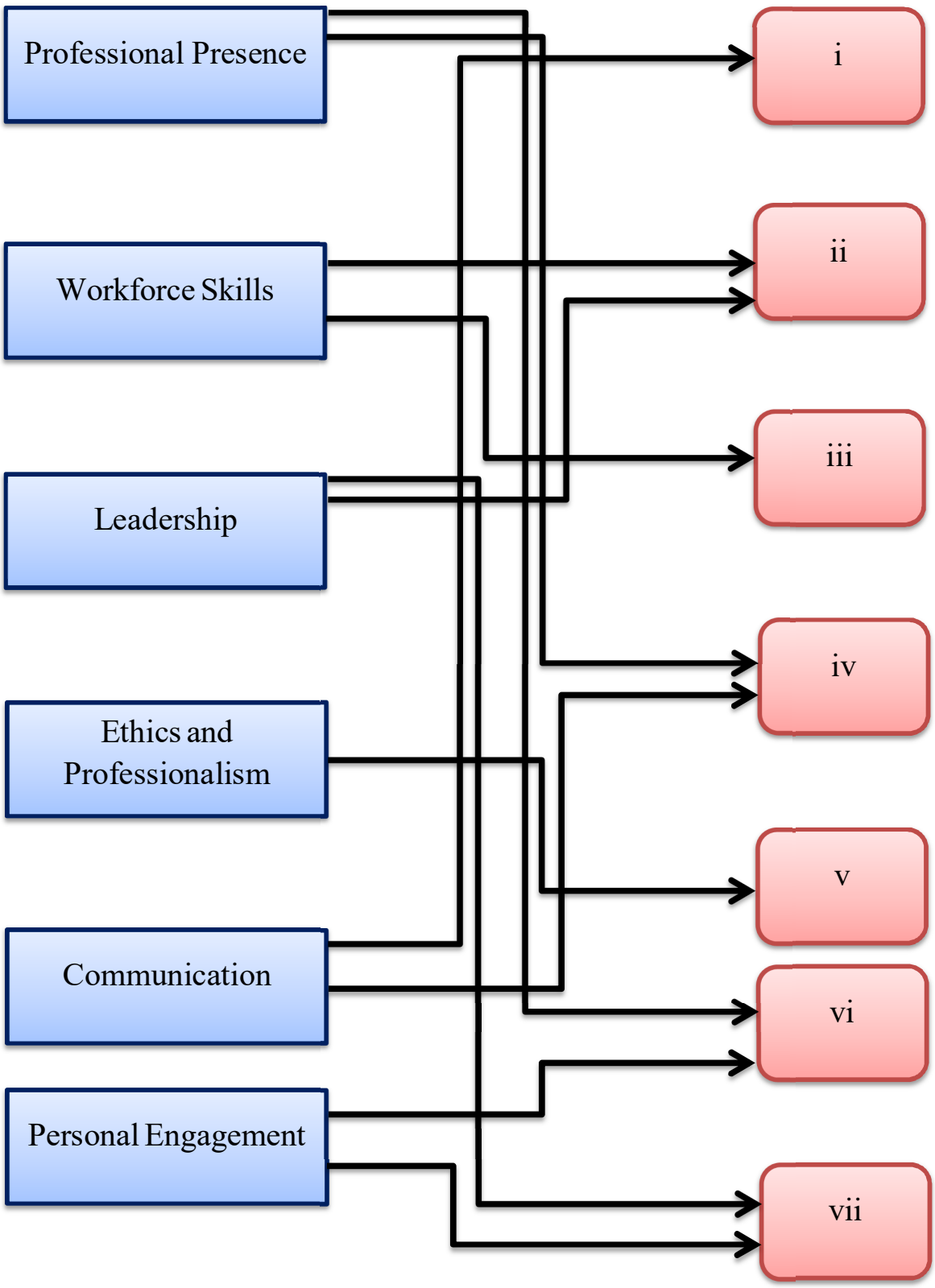
NGO-vi: An ability to perceive the continual necessity for professional knowledge growth and how to find, assess, assemble and apply it properly.

NGO-vi: An ability to work adequately on teams and to set up objectives, plan activities, meet due dates, and manage risk and uncertainty.

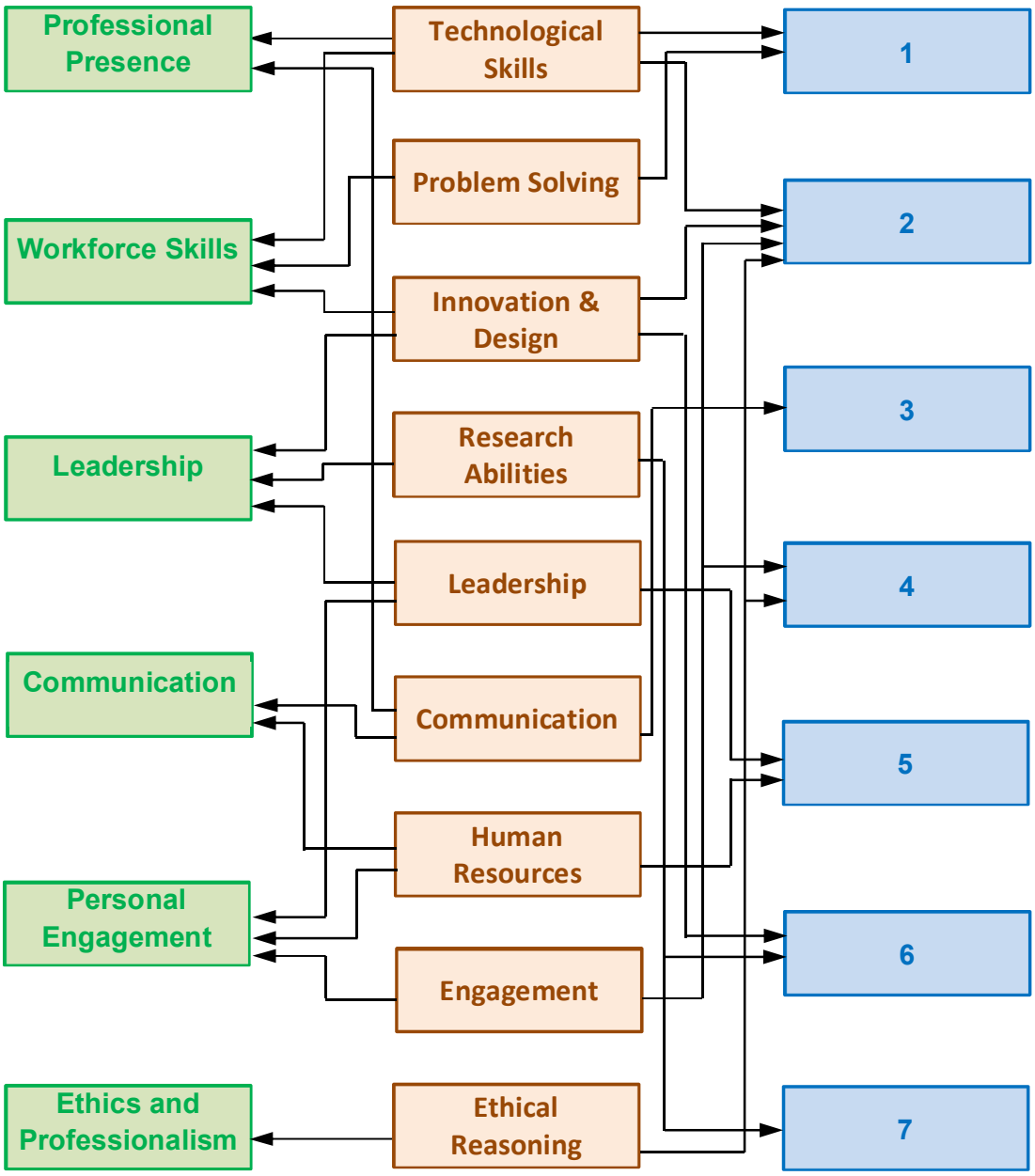
Relation between SOs (ABET) and NGOs (ICAEE)

SOs (ABET) / NGOs (ICAEE)						
1/i	2/ii	3/iv	4/v	5/vii	6/iii	7/vi

Linking PEO to SLO



The relation between college PEO's, SLO's and ABET SO's



The relation between college SO's and PEO's

SOs	PEOs					
	Professional Presence	Workforce Skills	Leadership	Ethics and Professionalism	Communication	Personal Engagement
1	√	√				
2	√	√	√	√		√
3	√					
4					√	√
5			√	√		√
6		√	√			
7			√		√	

The relation between college PEO's and SLOs

PEOs	SLOs								
	Technological Skills	Problem-Solving abilities	Innovation & Design	Research Abilities	Leadership	Communication	Human-Resources & Interaction	Engagement	Ethical Reasoning Behaviour
Professional Presence	√					√			
Workforce Skills	√	√	√						
Leadership			√	√	√				
Communication						√	√		
Personal Engagement					√		√	√	
Ethics and Professionalism									√

Relation between College SOs and SLOs

SOs	SLOs								
	Technological Skills	Problem-Solving abilities	Innovation & Design	Research Abilities	Leadership	Communication	Human-Resources & Interaction	Engagement	Ethical Reasoning Behaviour
1	√	√							
2	√		√					√	√
3						√			
4								√	√
5					√		√		
6			√	√					
7				√					

Course Description

Courses are coded as follows:

1. Course code and number

2. Course title

3. Parenthesized numerals, e.g., (4-3-1-3), indicate, in order, the credit hours, the classroom hours (1 hour = 1 credit hour), tutorial hours (credit hour = 0), and the laboratory hours (2 hours = 1 credit hour).

Prerequisites, if any, are indicated at the course description. These have been established to assure an adequate and uniform background for students in advanced classes. Occasionally, students may feel they already have the appropriate background for an advanced course because of previous training, transfer credits, or Credit by examination.

Course Numbering System:

Course code = **ME0000**
The number consists of **4** digits as following:
1000 - First year (Freshman) – (Fall and Spring Semesters)
2000 - Second year (Sophomore) – (Fall and Spring Semesters)
3000 - Third year (Junior) – (Fall and Spring Semesters)
4000 - Fourth year level (Senior) – (Fall and Spring Semesters)

100 - University Requirements
200 - College Requirements
300 - Department requirements

Numbers from 01, 02, 03, …etc. describes the sequence of the course in each LEVEL.

In order to refer to the elective subjects adopted at the fourth year; letter **E** will be added to the course code **ME0000** at its end to become **ME0000E.**

Courses and Credit Hours for Mechanical Engineering Department

Graduation Requirements

Requirements	Credit Hours
University Requirements	14
College Requirements	38
Department Requirements	87
ME Elective Classes	06
Total	145

University Requirements (14 credit hours)

Course Number	Course Title	Credit Hours	Weekly Hours
ME 1101	English Language- I	2	2
ME 1102	Arabic Language	2	2
ME 1103	Human Rights	1	1
ME 1104	Democracy	1	1
ME 2101	English Language- II	2	2
ME 3101	English Language -III	2	2
ME 3102	Management and Leadership Skills	2	2
ME 4101	English Language- IV	2	2
Total		14	14

College Requirements (38 credit hours)

Course Number	Course Title	Credit Hours	Weekly Hours		
			Lec.	Tut.	Lab
ME 1201	Calculus -I	3	3	1	--
ME 1202	Physics	4	3	-	2
ME 1203	Chemistry	4	3	-	2
ME 1204	Computer Science	3	2	1	3
ME 1205	Engineering Mechanics I (Static)	3	3	1	--
ME 1206	Fundamentals of Electrical Engineering	3	2	1	2
ME 1207	Calculus -II	3	3	1	--
ME 1208	Engineering Drawing	3	2	2	2
ME 2201	Calculus -III	3	3	1	--
ME 2202	Calculus- IV	3	3	1	--
ME 3201	Engineering Statistics	3	3	-	--
ME 3202	Engineering Numerical Methods	3	2	1	3
Total		38	32	10	12

Department Requirements: 87 Credit hours

Course Code	Course Title	Credit hours	Weekly hours		
			Lec.	Tut.	Lab
ME 1301	Principles of Manufacturing Process	3	2	1	2
ME 1302	Applied Physics	2	2	1	---
ME 2301	Fluid Mechanics -I	3	2	1	2
ME 2302	Strength of Materials -I	3	2	1	2
ME 2303	Thermodynamics -I	3	2	1	2
ME 2304	Engineering Metallurgy	3	2	1	2
ME 2305	Fluid Mechanics- II	3	2	1	2
ME 2306	Strength of Materials -II	3	2	1	2
ME 2307	Thermodynamics -II	3	2	1	2
ME 2308	Engineering Mechanics II(Dynamics)	2	2	1	---
ME 2309	Mechanical Drawing	3	2	1	2
ME 2310	Computer Programming	3	2	---	2
ME 2311	Electrical Machines	3	2	----	2
ME 3301	Engineering Analysis	2	2	2	---
ME 3302	Heat Transfer- I	3	2	1	2
ME 3303	Theory of Machines -I	3	2	1	2
ME 3304	Internal Combustion Engines	2	2	2	0
ME 3305	Manufacturing Processes	2	2	1	---
ME 3306	Research Methodology	1	1	---	---
ME 3307	Heat Transfer- II	3	2	1	2
ME 3308	Theory of Machines- II	3	2	1	2
ME 3309	Gas dynamics	2	2	2	---
ME 3310	Industrial Engineering and Economic Analysis	2	2	1	----
ME 4301	Design of Machine Elements -I	3	3	1	---
ME 4302	Air Conditioning	3	2	1	2
ME 4303	Power Plants	2	2	1	0
ME 4304	Mechanical Vibrations	3	2	1	2
ME 4305	Final Year Project- I	3	2	1	2
ME 4306	Design of Machine Elements -II	3	3	1	---
ME 4307	Refrigeration	3	2	1	2
ME 4308	Engineering Materials	2	2	1	---
ME 4309	Control Systems	2	2	2	---
ME 4310	Final Year Project- II	3	2	1	2
Total		87	67	34	40

Elective Courses (Max 6 Credit Hours)

Course Code	Elective Courses	Credit hours	Weekly hours
ME 4301E	Computer Applications	2	2
ME 4302E	Renewable Energy	2	2
ME 4303E	Finite Element Method	2	2
ME 4304E	Computational Fluid Dynamics	2	2
ME 4305E	Mechanics of Composite	2	2
ME 4306E	Fracture Mechanics	2	2
ME 4307E	Aerodynamics	2	2
ME 4308E	Artificial Intelligence	2	2
ME 4309E	CAD/CAM	2	2
ME 4310E	Corrosion Engineering	2	2
ME 4311E	Design of Heat Exchangers	2	2
ME 4312E	Electromechanics & Electronics	2	2
ME 4313E	Engineering Biomechanics	2	2
ME 4314E	Operation Research	2	2

Total Weekly Credit Hours = 145 **Total Weekly Hours = 215**

Requirements	Credit Hours	Weekly hours		
		Lec.	Tut.	Lab
University Requirements	14	14	-	-
College Requirements	38	32	10	12
Department Requirements	87	67	34	40
ME Elective Classes	06	06	-	-
Total	145	119	44	52
		215		

Total Contact Hours / Semester = 3225 (Weekly hours*15 weeks)

MED Courses

First Year (Freshman)

Semester I

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 1101	UR	English Language-I	2	-	-	2
ME 1102	UR	Human rights	1	-	-	1
ME 1104	UR	Democracy	1	-	-	1
ME 1201	CR	Calculus-I	3	1	-	3
ME 1202	CR	Physics	3	-	2	4
ME 1203	CR	Chemistry	3	-	2	4
ME 1206	CR	Fundamentals of Electrical Engineering	2	1	2	3
Total Hours and Credit Hours			15	2	6	18
			27			

Semester II

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 1103	UR	Arabic Language	2	-	-	2
ME 1205	CR	Engineering Mechanics I (Static)	3	1	-	3
ME 1204	CR	Computer Science	2	1	2	3
ME 1207	CR	Calculus-II	3	1	-	3
ME 1208	CR	Engineering Drawing	2	2	2	3
ME 1301	DR	Principles of Manufacturing Process	2	1	2	3
ME 1302	DR	Applied physics	2	1	0	2
Total Hours and Credit Hours			16	7	6	19
			25			

Second Year (Sophomore)

Semester I

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 2201	CR	Calculus-III	3	1	-	3
ME 2301	DR	Fluid Mechanics-I	2	1	2	3
ME 2302	DR	Strength of Materials-I	2	1	2	3
ME 2303	DR	Thermodynamics-I	2	1	2	3
ME 2308	DR	Engineering Mechanics-II(Dynamics)	2	1	-	2
ME 2309	DR	Mechanical drawing	2	1	2	3
ME 2311	DR	Electrical Machines	2	-	2	3
Total Hours and Credit Hours			15	6	10	20
			31			

Semester II

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 2101	UR	English Language-II	2	-	-	2
ME 2202	CR	Calculus-IV	3	1	-	3
ME 2304	DR	Engineering Metallurgy	2	1	2	3
ME 2305	DR	Fluid Mechanics-II	2	1	2	3
ME 2306	DR	Strength of Materials-II	2	1	2	3
ME 2307	DR	Thermodynamics-II	2	1	2	3
ME 2310	DR	Computer Programming	2	-	2	3
Total Hours and Credit Hours			15	5	10	20
			25			

Third Year (Junior)

Semester I

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 3101	UR	English Language-III	2	-	-	2
ME 3201	CR	Engineering Statistics	3	-	-	3
ME 3301	DR	Engineering Analysis	2	2	-	2
ME 3302	DR	Heat Transfer-I	2	1	2	3
ME 3303	DR	Theory of Machines-I	2	1	2	3
ME 3304	DR	Internal Combustion Engines	2	2	-	2
ME 3309	DR	Gas Dynamics	2	2	-	2
Total Hours and Credit Hours			15	8	4	17
			27			

Semester II

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 3102	UR	Management and Leadership Skills	2	0	-	2
ME 3202	CR	Engineering Numerical Methods	2	1	2	3
ME 3305	DR	Manufacturing Processes	2	1	-	2
ME 3306	DR	Research Methodology	1	-	-	1
ME 3307	DR	Heat Transfer-II	2	1	2	3
ME 3308	DR	Theory of Machines-II	2	1	2	3
ME 3310	DR	Industrial Engineering and Economic Analysis	2	1	-	2
Total Hours and Credit Hours			13	5	6	16
			24			

Fourth Year (Senior)

Semester I

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 4301	DR	Design of Machine Elements-I	3	1	-	3
ME 4302	DR	Air Conditioning	2	1	2	3
ME 4303	DR	Power Plants	2	1	-	2
ME 4304	DR	Mechanical Vibrations	2	1	2	3
ME 4308	DR	Engineering Materials	2	1	-	2
ME 4303 E	DR	Finite Element Method (FEM)	2	-	-	2
ME 4305	DR	Final Year Project-I	2	1	2	3
Total Hours and Credit Hours			15	6	6	18
			27			

Semester II

Course Code	Category	Course Title	Weekly Hours: Theoretical	Tutorial	Practical	Credit Hours
ME 4101	UR	English Language-IV	2	-	-	2
ME 4306	DR	Design of Machine Elements-II	3	1	-	3
ME 4307	DR	Refrigeration	2	1	2	3
ME 4309	DR	Control Systems	2	2	-	2
ME 4302 E	DR	Renewable Energy	2	-	-	2
ME 4304 E	DR	Computational Fluid Dynamics (CFD)	2	-	-	2
ME 4310	DR	Final Year Project-II	2	1	2	3
Total Hours and Credit Hours			15	5	4	17
			24			

ME Program Outcome Curriculum Map According to NGO's Criterion

First Year (Freshman) – First Semester (Fall Semester)							
Course subjects	i	ii	iii	iv	v	vi	vii
Calculus-I	X						
Physics	X		X				
Computer Science	X					X	
Chemistry	X		X				
Principles of Manufacturing Processes	X					X	
English Language-I				X			
Human Rights					X		
First Year (Freshman) – Second Semester (Spring Semester)							
Course subjects	i	ii	iii	iv	v	vi	vii
Calculus II	X						
Applied Physics	X		X				
Engineering Mechanics I(Static)	X						
Engineering Drawing	X					X	
Fundamentals of Electrical Engineering	X		X				
Arabic Language				X			
Democracy					X		

Second Year (Sophomore) – First Semester (Fall Semester)							
Course subjects	i	ii	iii	iv	v	vi	vii
Calculus III	X						
Fluid Mechanics I	X		X				
Strength of Materials I	X		X				
Thermodynamics I	X		X				
Engineering Mechanics II (Dynamics)	X						
Mechanical Drawing	X					X	
Electrical Machines	X		X				
Second Year (Sophomore) – Second Semester (Spring Semester)							
Course subjects	i	ii	iii	iv	v	vi	vii
Calculus IV	X						
Fluid Mechanics II	X		X				
Strength of Materials II	X		X				
Thermodynamics II	X		X				
Engineering Metallurgy	X		X				
Computer Programming	X					X	
English Language II				X			

Third Year (Junior)– First Semester (Fall Semester)							
Course subjects	**i**	**ii**	**iii**	**iv**	**v**	**vi**	**vii**
Engineering Analysis	X						
Heat Transfer I	X	X	X				
Theory of Machines I	X	X	X				
Internal Combustion Engines	X	X	X				
Gas Dynamics	X	X					
Engineering Statistics	X				X		
Research Methodology				X	X	X	
English Language III				X			
Third Year (Junior)– Second Semester (Spring Semester)							
Course subjects	**i**	**ii**	**iii**	**iv**	**v**	**vi**	**vii**
Engineering Numerical Methods	X						
Heat transfer II	X	X	X				
Theory of Machines II	X	X	X				
Manufacturing Processes	X	X	X				
Management and Leadership Skills					X	X	X
Industrial Engineering and Economic Analysis		X			X	X	

Fourth Year (Senior)– First Semester (Fall Semester)							
Course subjects	**i**	**ii**	**iii**	**iv**	**v**	**vi**	**vii**
Design of Machine Elements I		X					
Air Conditioning		X	X				
Power Plants		X	X				
Mechanical Vibrations	X		X				
Engineering Materials		X				X	
Computer Applications		X	X				X
Final Year Project I	X	X	X	X	X	X	X
Fourth Year (Senior)– Second Semester (Spring Semester)							
Course subjects	**i**	**ii**	**iii**	**iv**	**v**	**vi**	**vii**
Design of Machine Elements II		X					
Refrigeration		X	X				
Control Systems	X	X					
ME Elective Class II	X	X					
ME Elective Class III	X	X					
English Language IV				X			
Final Year Project II	X	X	X	X	X	X	X

Fourth Year Elective Courses							
Renewable Energy	X	X					
Computational Fluid Dynamics	X	X					
Fracture Mechanics	X	X					
Mechanics of Composite Materials	X	X					
Computer Applications	X	X					
Finite Element Method	X	X					
Aerodynamics	X	X					
Artificial Intelligence	X	X					
CAD/CAM	X	X					
Corrosion Engineering	X	X					
Design of Heat Exchangers	X	X					
Electromechanics & Electronics	X	X					
Engineering Biomechanics	X	X					
Operation Research	X	X					

Program Outcome Curriculum Map According to ABET Criterion

SOs (ABET)	1	2	3	4	5	6	7
NGOs (ICAEE)	i	ii	iv	v	vii	iii	vi

First Year (Freshman) – First Semester (Fall Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Calculus I	X						
Physics	X					X	
Computer Science	X		X				
Chemistry	X					X	
Principles of Manufacturing Processes	X		X				
English Language I				X			
Human Rights				X			
First Year (Freshman) – Second Semester (Spring Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Calculus II	X						
Applied Physics	X					X	
Engineering Mechanics I (Static)	X						
Engineering Drawing	X						X
Fundamentals of Electrical Engineering	X					X	
Arabic Language			X				
Democracy				X			

Second Year (Sophomore) – First Semester (Fall Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Calculus III	X						
Fluid Mechanics I	X					X	
Strength of Materials I	X					X	
Thermodynamics I	X					X	
Engineering Mechanics II (Dynamics)	X						
Mechanical Drawing	X						X
Electrical Machines	X					X	
Second Year (Sophomore) – Second Semester (Spring Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Calculus IV	X						
Fluid Mechanics II	X					X	
Strength of Materials II	X					X	
Thermodynamics II	X					X	
Engineering Metallurgy	X					X	
Computer Programming	X						X
English Language II			X				

Third Year (Junior)– First Semester (Fall Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Engineering Analysis	X						
Heat Transfer I	X	X				X	
Theory of Machines I	X	X				X	
Internal Combustion Engines	X	X				X	
Gas Dynamics	X	X					
Engineering Statistics	X			X			
Research Methodology			X	X			X
English Language III			X				
Third Year (Junior)– Second Semester (Spring Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Engineering Numerical Methods	X						
Heat transfer II	X	X				X	
Theory of Machines II	X	X				X	
Manufacturing Processes	X	X				X	
Ethics and Leadership Skills				X	X		X
Industrial Engineering and Economic Analysis		X		X			X

Fourth Year (Senior)– First Semester (Fall Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Design of Machine Elements I		X					
Air Conditioning		X				X	
Power Plants		X				X	
Mechanical Vibrations	X					X	
Engineering Materials		X					X
Computer Applications		X			X	X	
Final Year Project I	X	X	X	X	X	X	X
Fourth Year (Senior)– Second Semester (Spring Semester)							
Course subjects/ SOs (ABET)	1	2	3	4	5	6	7
Design of Machine Elements II		X					
Refrigeration		X				X	
Control and Measurements	X	X					
ME Elective Class II	X	X					
ME Elective Class III	X	X					
English Language IV			X				
Final Year Project II	X	X	X	X	X	X	X

Program Outcome Curriculum Map According to SLOs Programme

Programme SLOs	1	2	3	4	5	6	7	8	9
ABET SO's	1+2+6	1	2+6	6+7	5	3	5	4	2+4
First Year – First Semester (Fall Semester)									
Calculus -I	X	X							
Physics -I	X	X		X			X		
Computer Science	X	X		X			X		
Chemistry	X	X					X		X
Fundamentals of Electrical Engineering	X	X		X			X		
English Language-I						X			
Human Rights					X			X	X
First Year – Second Semester (Spring Semester)									
Calculus -II	X	X							
Physics -II	X	X		X			X		
Engineering mechanics I (Static)	X	X	X	X			X		
Engineering drawing	X								
Principles of Manufacturing Process	X	X			X	X			
English language-II						X			
Democracy					X			X	X

Second Year – First Semester (Fall Semester)									
Calculus- III	X	X							
Fluid Mechanics-I		X	X						X
Strength of Materials-I	X	X	X	X			X		
Thermodynamics-I		X	X						X
Engineering mechanics II (Dynamics)	X	X	X	X			X		
Computer Programming	X	X		X			X		
Arabic Language						X			
Second Year – Second Semester (Spring Semester)									
Calculus -IV	X	X							
Fluid Mechanics-II		X	X						X
Strength of Materials-II	X	X	X	X			X		
Thermodynamics-II		X	X						X
Engineering Metallurgy		X	X						X
Mechanical Drawing	X	X	X	X		X			

Third Year – First Semester (Fall Semester)									
Engineering Analysis	X	X	X						X
Heat Transfer I		X	X	X					
Theory of Machines I	X	X	X	X					X
Internal Combustion Engines		X	X	X					X
Manufacturing Processes		X	X	X					X
Engineering Statistics	X	X	X						X
Research Methodology									X
Third Year – Second Semester (Spring Semester)									
Engineering Numerical Analysis		X							
Heat Transfer II		X	X	X					
Theory of Machines II	X	X	X	X					X
Gas Dynamics		X	X						X
Electrical Machines		X	X	X					X
Industrial Engineering and Economic Analysis	X	X	X	X					
Ethics and Leadership Skills									X

Fourth Year – First Semester (Fall Semester)									
Design of Machine Elements I	X	X	X	X			X		X
Air Conditioning		X	X	X					
Power Plants	X	X	X						X
Mechanical Vibrations		X	X	X					
Industrial Engineering & Safety		X	X	X			X		X
Me Elective Class I									
Final Year Project I	X	X	X	X	X	X	X	X	X

Fourth Year – Second Semester (Spring Semester)									
Design of Machine Elements II	X	X	X	X			X		X
Regeneration		X	X	X					
Engineering Materials		X	X	X					
Control and Measurements		X	X						X
Me Elective Class II									
Me Elective Class III									
Final Year Project II	X	X	X	X	X	X	X	X	X

Fourth Year - Elective Courses									
Renewable Energy	X	X					X	X	
Computational Fluid Dynamics									
Fracture Mechanics	X	X		X					
Mechanics of Composite Materials	X	X	X	X			X		
Computer Applications									
Finite Element Method	X	X	X	X					
Aerodynamics	X	X					X	X	
Artificial Intelligence									
CAD/CAM	X	X	X	X	X	X			
Corrosion Engineering	X	X	X	X					
Design of Heat Exchangers									
Electromechanics & Electronics									
Engineering Biomechanics									

University Requirements Courses

ME 1101 - English Language-I (2-2-0-0)

Prerequisites:

None

Course Description

This course is designed to enable academic writing course which provides an opportunity for the students to learn and practice the skills needed for handling topics related to the field of study. The course emphasizes the development of academic writing skills as well as the ability to read and think critically. Students will learn to use the library and appropriate online resources to find and evaluate sources to inform, develop and support their ideas in term paper writing. They will also learn skills for reading analysis, such as comprehension and inference.

Course Topics:

1. Am/ are/ is, my/ your
   - How are you?
   - What's this in English?
   - Plurals
   - This is .....
   - Good morning!
   - Numbers 1-10
2. Countries
   - Where's he from?
   - Numbers 11-30
   - He/ she/ they, his/ her
   - Fantastic/ awful/ beautiful
3. Jobs
   - Negatives and questions
   - Social expressions-1
   - Am/are/is
   - Personal information
4. Our/ their
   - The family
   - The alphabet
   - Possessive's
   - Has/ have
5. Sports/ food/ drinks
   - a/ an
   - Numbers and prices
   - Present simple- I/ you/ we/ they
   - languages and nationalities
6. The time
   - Always/ sometimes/ never
   - Days of the week
   - Present simple- he/ she
   - Words that go together
7. Question words
   - This/ that
   - me|him|us|then
   - adjectives
8. Rooms and furniture
   - Prepositions
   - There is/ are
   - Directions
9. Saying years
   - As/ were born

	• Past simple- irregular verbs • When's your birthday?	• Have/ do/ go
10.	• Past simple- regular and irregular • Sport and leisure	• Questions and negatives • Going sightseeing
11.	• Can/ can't • Adjective+ noun	• Adverbs • Everyday problems
12.	• I'd like- some/ any • Signs all around	• In a restaurant

Program and Course Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Develop academic writing proficiency and critical thinking skills
2. Students are able to conduct effective searches of printed and electronic resources
3. Students can use external sources to support ideas in an academic writing in mechanical engineering
4. Students can identify and explain the academic integrity (how to avoid plagiarism)
5. Students are familiar with the citation methods like the APA style
6. Students can participate in a classroom community that involves constructive exchange of ideas

Recommended Textbook(s):

John & Liz Soars, "New Headway Plus- Beginner Student's Book", 10th ed 2014

ME 1102 - Human Rights (1-1-0-0)

Prerequisites:

None

Course Description

This course is designed to give the student the definition of freedom and the right language and idiomatically and legitimacy of the user, Origin of the right in the eyes of Islamic law, Elements of the right and types of, Personal freedom, Intellectual freedom, Rights and economic freedoms,Islam and Slavery, Human rights objectives, The use of freedom and the right general project, Theright of a Muslim to his Muslim brother, Parental rights, Right neighbor, The right of women,Human rights in the heavenly religions, Religious tolerance in Islam.

Course Topics:

1. The definition of freedom and the right
2. Origin of the right in the eyes of Islamic law
3. Elements and Types of the Human right
4. Rights and economic freedoms
5. Islam and Slavery
6. Human rights objectives
7. The use of freedom and the right general project
8. The right of a Muslim

Course Learning Outcomes:

Upon the successful completion of this course, students will be able to:

1. Evaluate Human rights
2. Preservation of human rights in Islam
3. Evaluation of relationship between human rights and democracy

Recommended Textbook(s)

By Topics

ME 1103 - Arabic Language (2-2-0-0)

Prerequisites:

None

Course Description

This course aims at building students' familiarity with and competence in Arabic literature in its various genres so as to increase their ability to appreciate literature and to develop their awareness of its concepts through the study of poetry, novel and the short story.

Course Topics:

Study the text of the Quran and analysis, In the language and spelling and rules, the rules of writing the hamza, Written verbatim by Arab and Za - Rules of number and numerical adjective,punctuation, the method of detection for words in Arabic Dictionaries, In the

applications of grammar and language- the actor and his deputy, Debutante and the news Acts missing, Equated with the letters already Byproducts, The case and exception, Ancient literary studies, Definition of literature and its importance, Ages historical Arabic literature – Modern Literary Studies, Study the texts of poetic eras (pre-Islamic, Islamic, Umayyad, Abbasid, Andalusia), Study of ancient prose texts (speeches, messages), examine the texts of modern poetry and contemporary, examine the texts of modern prose (drama, novel, article)

Course Learning Outcomes:

1. Develop academic essay writing proficiency.
2. Promote reading skills.
3. Expand academic vocabulary through reading.
4. Promote critical thinking skills.

Recommended Textbook(s):

By Topics

ME 1104 - Democracy (1-1-0-0)

Prerequisites:

ME 1102 - Human Rights

Course Description

This course is designed to give the student the definition of freedom democracy, the concept of democracy, history of democracy, the properties of democracy, traditional Greek democracy, its principles, modern democracy, and pressure groups.

Course Topics:

1. The concept of democracy
2. History of democracy
3. The properties and principle of democracy
4. Traditional Greek democracy and modern democracy
5. The relationship between human rights and democracy
6. Pressure groups

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Learn what democracy?
2. Democratic approach in Islam and its applications
3. Accepts differing views
4. Evaluation of pressure groups

Recommended Textbook(s):

By Topics

ME 2101 - English Language II (2-2-0-0)

Prerequisites:

ME 1101 - English Language-I

Course Description

This course is designed to enable the students to achieve academic oral and written communication to the standard required at university level. The course integrates all the language skills with emphasis on writing, and it stimulates students' imagination, and promotes personal expression. Students, in this course, are trained to apply critical thinking skills to a wide range of challenging subjects from diverse scientific topics. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary, and getting involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings in mechanical engineering.

Course Topics:

1	- Tenses	- Question forms
	- Vocabulary (Jobs)	- Writing (informal letter)
2	- Present simple	- Have/have to
	- Present continuous	- Writing (Linking words +Describing a person)
3	- Past simple	- Have + noun
	- Past continuous	- Writing (a story 1)
4	- Count and uncount nouns	- Articles
	- Expression of quantity	- Vocabulary (clothes)
		- Writing (filling in forms)
5	- Verb patterns	- Will and going to

	- Would like and like	- Writing (postcard)
6	- What … like?	- Vocabulary (adjective formation)
	- Comparative and superlatives	- Writing (relative closes)
8	- Present perfect	- Vocabulary (men and women)
	- Tense revision	- Writing (a biography)
9	- have to & got to	- Vocabulary (job description)
	- have to & should & must	- Writing (formal letter)
10	- Present simple or will	- Time clauses
	- Conditional clauses	- Writing (discussing ideas)
11	- Verb patterns	- Infinitives
	- Used to	- Writing (formal letters)
12	- The passive form	- Vocabulary (words with more than one
	- Active and passive	- Writing (email)
13	- Second conditional	- Vocabulary (phrasal verbs)
	- Might	- Writing (a story 2)

Program and Course Outcomes:

1. Develop academic essay writing proficiency
2. Promote reading skills
3. Expand academic vocabulary through reading
4. Promote speaking ability through group discussions and debates
5. Promote critical thinking skills

Recommended Textbook(s):

John & Liz Soars, "New Headway Plus- Beginner Student's Book", 10th ed 2014

ME 3101- English Language-III (2-2-0-0)

Prerequisites:

ME 2101 - English Language-II

Course Description

This course is designed to enable the students to achieve academic oral and written communication to the standard required at university level. The course integrates all the language skills with emphasis on writing, and it stimulates students' imagination, and promotes personal expression. Students, in this course, are trained to apply critical thinking skills to a wide range of challenging subjects from diverse scientific topics. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary, and getting

involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings in mechanical engineering.

Course Topics:

1.
   - Auxiliary verbs
   - Grammar revision
   - Vocabulary
   - Pronunciation
   - Prepositions
   - **Writing** (Correcting mistakes 1)
   - **Reading** (Wonders of the modern world)
   - **Listening and speaking** (My wonders)
2.
   - Present simple
   - Pronunciation revision
   - Present states and actions
   - Vocabulary
   - Phrasal verbs
   - **Reading and speaking** (I'm a clown doctor!)
   - **Writing** (Letters and emails)
3.
   - Past simple and past continuous
   - Grammar revision
   - Past perfect
   - Past passive
   - Vocabulary
   - Prepositions revision
   - **Listening and writing** (Books and films)
   - **Writing** (Narrative 1)
   - **Everyday English** (Giving opinions)
4.
   - Have to /don't have to
   - Can and be allowed to
   - Should
   - Must and have to
   - Vocabulary
   - Pronunciation
   - **Listening and speaking** (Come round to my place!)
   - **Writing** (For and against)
5.
   - Future form 1
   - Future form 2
   - Grammar revision
   - Vocabulary
   - Pronunciation
   - Prepositions revision
   - **Reading and speaking** (Hotels with a difference)
   - **Writing** (Making a reservation)
6.
   - Like
   - Grammar review
   - Verb patterns
   - Vocabulary

- Pronunciation
- Phrasal verbs
- **Listening and speaking** (New York and London)
- **Everyday English** (Signs and sounds)
- **Writing** (A description 1)

7.
- Present perfect
- Tense review
- Present perfect passive
- Vocabulary
- Pronunciation
- Prepositions
- **Reading and speaking** (Dream jobs)
- **Listening and speaking** (The busy life of a retired man)
- **Writing** (A letter of application)

8.
- Conditionals 1 and time clauses
- Conditionals 2
- Vocabulary
- Pronunciation
- Phrasal verbs
- **Reading and speaking** (Who wants to be a millionaire)
- **Everyday English** (Making suggestions)
- **Writing** (Narrative 2)

9.
- Modal verbs of probability in the present
- Modal verbs of probability in the past
- Vocabulary
- Pronunciation
- Prepositions
- **Listening and speaking** (Brothers and sisters)
- **Writing** (A description 2)

10
- Present perfect continuous
- Simple and continuous revision
- Time expressions
- Vocabulary
- Pronunciation
- Prepositions
- **Reading and speaking** (A big name in Hollywood)
- **Listening and speaking** (Collectors)
- **Writing** (Writing a biography)

11
- Indirect questions
- Grammar revision
- Question tags
- Vocabulary and pronunciation
- Phrasal verbs
- **Listening and speaking** (The forgetful generation)
- **Writing** (Words that joint ideas)
- **Everyday English** (Informal English)

12
- Reported statements and questions
- Reported commands
- Vocabulary

- Pronunciation
- Phrasal verbs
- Revision
- **Reading and speaking** (A death)
- **Listening and speaking** (My way)
- **Writing** (Correcting mistakes 2)

Program and Course Outcomes:

- Develop academic writing
- Apply reading skills
- Expand academic vocabulary through reading
- Ability to speaking through group discussions and debates

Recommended Textbook(s):

John & Liz Soars, "New Headway Plus- Beginner Student's Book", 10th ed 2012

ME 3102 - Administration and Leadership Skills (2-2-0-0)

Prerequisites:

None

Course Description

This course is designed for engineering students who are interested in advancing into management and leadership roles. You will gain a perspective on what it is like to be an engineering leader. You will develop awareness of your own strengths and weaknesses as a leader when you are placed in charge of a project. You will learn how to leverage your strengths and control your weaknesses. You will also learn how to manage relationships with your team members and how to set up a creative environment for your team to motivate each team member to reach his or her potential. You will also learn how to deal with different ethical issues that are related to engineering field.

Course Topics:

1. **Introduction to leadership**
   - Leadership definition
   - Can one person make a difference?

Why is leadership important for engineers? Are leaders born or made?
Personality assessment

2. **Leadership and management styles**

Command leadership vs. servant leadership Characteristics of servant leader Management styles
Leader or manger?
The outstanding leader competencies

3. **Effective team leadership**

What is team
Why work in teams?
Different types of teams
Team roles
Role of team leader

4. **Practical Implementation**

Time management (first things first) Project related activities
Conducting Effective Meetings Giving effective feedback Recognition and reward

5. **Communication**

Communication types
Thoughts emotion and communication (head, heart and hands) What influences our communication
Damaging communication habits
Connecting with others
Peer communication assessment

6. **Leadership and management styles**

Management styles
Attributes of the engineering leader
Modern leadership
Characteristics of servant leader
Command leadership vs. servant leadership

7. **Professional Ethics**

Definition
Origins
Principles

8. **Introduction to Engineering Ethics**

Professional Codes of Ethics

9. **Ethical Issues in Engineering Practice**
   1 -Safety Considerations
   2- The Role of Good Design
      A- Sustainable design and design for all
      B- Safety and risk in Design
   3- Environmental Ethics
10. **Steps in Confronting Moral Dilemmas**
11. **Case Studies**

Course Learning Outcomes:

Following completion of this course, students will be able to:

1- Explain the basic concepts of leadership.

2- Build power and influence.

3- Add value to their sphere of influence

4- Give and receive feedback, actively listen, provide supportive communication, and coach and counsel their team members.

Recommended Textbook(s):

1- Benator, Barry and Thumann, Albert "Project Management and Leadership Skills for Engineering and Construction Projects." 2003, The Fairmont Press, Inc., USA

2- Fleddermann, C. B. (2012). Engineering Ethics. Upper Saddle River, NJ: Prentice Hall.

3- Code of Ethics- Iraqi Engineers Association

ME 4101 - English Language -IV (2-2-0-0)

Prerequisites:

ME 3101- English Language-III

Course Description

This course is designed to enable the students to achieve academic oral and written communication to the standard required at university level. The course integrates all the language skills with emphasis on writing, and it stimulates students' imagination, and promotes personal expression. Students, in this course, are trained to apply critical thinking skills to a wide range of challenging subjects from diverse scientific topics. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary,

and getting involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings in mechanical engineering.

Course Topics:

1. • **Grammar** (The tense system and spoken English)
   • **Vocabulary** (Compound of words lifestyle, home town, house-proud)
   • **Reading** (A home from home-two people describe their experiences of living abroad)
   • **Listening** ('things I miss from home')
   • **Speaking** (Exchanging information about people who live abroad)
   • **Everyday English** (Social expressions)
   • **Writing** (Applying for a job)
2. • **Grammar** (Present perfect, simple and continuous, and spoken English)
   • **Vocabulary** (Hot verbs, make, do make way, do damage)
   • **Reading** ('Paradise Lost'- how tourism is destroying the object of its affection)
   • **Listening** (An interview Tashi Wheeler about her travels as child with parents)
   • **Speaking** (Information Gap)
   • **Everyday English** (Exclamations)
   • **Writing** (Informal letters and correcting mistakes)
3. • **Grammar** (Narrative tenses, past simple, Conts, and Perfect)
   • **Vocabulary** (books and films)
   • **Reading** (Jane Austen-one of the world's most downloaded authors)
   • **Listening** (The money jigsaw-a news item from BBC's radio)
   • **Speaking** (Retelling a news story, responding to a news)
   • **Everyday English** (Showing interest and surprise)
   • **Writing** (Narrative writing 1)
4. • **Grammar** (questions and negatives and spoken English)
   • **Vocabulary** (Prefixes and Antonyms in context)
   • **Reading** ('Diana and Elvis shot JFK!)
   • **Listening** ('My most memorable lie'-people confess to untruths)
   • **Speaking** (Discussion-good and bad lies)
   • **Everyday English** (Being polite)
   • **Writing** (Linking ideas)
5. • **Grammar** (Future forms and spoken English)
   • **Vocabulary** (Hot verbs-take, put)
   • **Reading** ('Today's teenagers are just fine')
   • **Listening** arranging to meet-three friends decide a time and a place to get together)
   • **Speaking** (Future possibilities in your life)
   • **Everyday English** (Telephone conversations)
   • **Writing** (writing Emails)
6. • **Grammar** (Expression of quantity)
   • **Vocabulary** (Words with variable stress)
   • **Reading** (A profile of two famous brands)

- **Listening** (Radio advertisements-what's the product? What are the selling points?)
- **Speaking** (A lifestyle survey)
- **Everyday English** (Business expression, Numbers, Fractions, decimals, date, time…)
- **Writing** (A consumer survey)

7. • **Grammar** (Modals and related verbs 1, spoken English, Declarative questions, and Question expressing surprise)
   - **Vocabulary** (Hot verb-get)
   - **Reading** ('Meet the kippers'-an article about grown-up children who won't leave home)
   - **Listening** (Getting married-an Indian lady talks about her marriage)
   - **Speaking** (The pros and cons of arranged marriage)
   - **Everyday English** (Exaggeration and understatement)
   - **Writing** (Arguing your case)
8. • **Grammar** (Relative clauses)
   - **Vocabulary** (Adverb collocations and adverb adjectives)
   - **Reading** ('Chukotka, the coldest place on earth'-an article about a remote territory of Russia)
   - **Listening** (Extreme experiences-people describe their experiences in extreme weather conditions)
   - **Speaking** (Making descriptions longer, talking about your experiences)
   - **Everyday English** (The world around)
   - **Writing** (Describing places)
9. • **Grammar** (Expressing habit)
   - **Vocabulary** (Homonyms and Homophones)
   - **Reading** ('People and their money-an article about three very different people)
   - **Listening** (A teacher I will never forget-people describe a teacher who made a lasting impression on them)
   - **Speaking** (Discussion-a teacher I'll never forget)
   - **Everyday English** (Making your point)
   - **Writing** (Writing of talking)
10. • **Grammar** (Modal auxiliary verbs 2)
    - **Vocabulary** (Synonyms)
    - **Reading** ('How the West was won'-the story of settlers in nineteenth -century America)
    - **Listening** (Hilaire Belloc's Tales for children)
    - **Speaking** (The murder game-one man drops dead in a country house :)
    - **Everyday English** (Metaphors and idioms-the body)
    - **Writing** (Formal and informal letters and Emails)
11. • **Grammar** (Hypothesizing)
    - **Vocabulary** (Word pairs)

- **Reading** ('Have you ever wondered'? -the answers to some important questions in life)
- **Listening** (The interpretation of dreams-paul's amazing dream)
- **Speaking** (Practicing a conversation and describing your dreams)
- **Everyday English** (Moans and groans)
- **Writing** (narrative writing 2)

12.
- **Grammar** (Articles)
- **Vocabulary** (Hot words-life and time)
- **Reading** ('you are never too old'-A life in the day of Mary Hobson, who gained her PhD aged)
- **Listening** (happy days-people talk about what make them happy and unhappy)
- **Speaking** (Discussion-the different ages of life, and their pros and cons)
- **Everyday English** (Linking and commenting)
- **Writing** (Adding emphasis in writing)

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

- Develop academic essay writing proficiency
- Promote reading skills
- Expand academic vocabulary through reading
- Promote speaking ability through group discussions and debates
- Promote critical thinking skills

Recommended Textbook(s):

John & Liz Soars, "New Headway Plus- Beginner Student's Book", 10th ed 2014

COLLEGE REQUIREMENT COURSES

ME 1201 – Calculus-I (3-3-1-0)

Prerequisites:

None

Course Description

This course provides a comprehensive guide and up-to-date treatment of engineering mathematics with an in-depth overview of the many mathematical. It is intended to introduce students of engineering, physics, mathematics, computer science, and related fields to those areas of applied mathematics that are most relevant for solving practical problems.

Course Topics:

1. Tangent line and slope problems.
2. Drawing of functions
3. Continuity and limit of functions
4. Limits at infinity, horizontal asymptote. infinite limits, vertical asymptotes and drawing of functions
5. Derivative of functions and rates of change. Differentiation of polynomials, product and quotient rules
6. Derivatives of exponential, logarithmic, and trigonometric functions
7. Chain rule and implicit differentiations
8. Applications of differentiation maximum and minimum values. the mean value theorem 9. Derivative of hyperbolic functions and indeterminate forms and l'hospital's rule.
10. Optimization problems and anti-derivative of functions

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. To develop mathematical skill so that students are able to sketch the graph of various functions and evaluates Limits by using different techniques including L'Hopital's Rule.

2. Apply mathematical methods and principals in solving various derivative problems from Engineering fields, involving applications of derivatives.

3. Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithmic, and trigonometric functions,

4. Compute derivative and anti- derivative of algebraic, trigonometric, inverse trigonometric, exponential, logarithmic, and apply them to solve problems in a wide range of engineering applications.

Recommended Textbook(s):

1. Stewart, J., Clegg, D. K., & Watson, S. (2020). Calculus: early transcendentals. Cengage Learning.

2. Thomas, G. B., Haas, J., Heil, C., & Weir, M. (2018). Thomas' Calculus. Pearson Education Limited.

3. Stroud, K. A., & Booth, D. J. (2020). Engineering mathematics. Bloomsbury Publishing.

ME 1202 – Physics (4-3-0-2)

Prerequisites:

ME 1201 Calculus I

Course Description

This is the first course in the two-semester sequence of calculus-based introductory physics courses designed to meet the needs of student majoring in Engineering. The course is a survey of the concepts, principles, methods and major findings of classical Physics. Primarily, it covers Newtonian mechanics, and thermal Physics, with topics include: Physics and measurement, Vectors, kinematics and dynamics of motion of a single particle in one and two dimensions, work and energy, system of particles, linear momentum and collisions, kinematics and dynamics of rotational motion, equilibrium of rigid bodies, and elasticity, fluid static and fluid dynamics, oscillatory motion, wave motion, and temperature and thermal equilibrium.

Course Topics:

1-Physics and measurement

1.1- Standards of Length , Mass and Time
1.2- Density of Atomic Mass
1.3- Dimensional Analysis
1.4- Conversion of Units
1.5- Estimate and Order of Magnitude Calculations
1.6- Significant Figures

2- Motion in One Direction

2.1-Particle Model
2.2- Position, Velocity and Speed
2.3-Instantaneous Velocity and Speed
2.4- Acceleration
2.5-One-Dimensional Motion with Constant Acceleration
2.6- Freely Falling Object

3- Vectors

3.1-Coordinate System
3.2- Vector and Scalar Quantity
3.3-Some Properties of Vectors
3.4- Adding Vectors
3.5-Subtracting Vectors
3.6-Component of Vectors and Unit Vectors

4- Motion in Two Dimension

4.1- The Position , Velocity and Acceleration Vectors
4.2- Two Dimensional Motion with Constant Acceleration
4.3-Projectile Motion
4.4- Horizontal Range and Maximum Height of a Projectile
4.5- Uniform Circular Motion
4.6- Tangent and Radial Acceleration
4.7- Relative Velocity and Relative Acceleration

5- The Laws of Motion

5.1- Newton's First Law and Inertial Frames
5.2- Mass
5.3- Newton's Second Law
5.4- The Gravitational Force and weight

5.5- Newton's Third Law
5.6- Forces and Friction
5.7- Experimental Observations

6- Circular Motion and Other Applications of Newton's Law

6.1- Non uniform Circular Motion
6.2- Resistance Force Proportional to Object Speed
6.3- Air Drag at High Speed

7- Temperature

7.1- Zeroth Law of Thermodynamics
7.2- Thermometers and The Celsius Temperature Scale
7.3- The Constant Volume Gas Thermometer and The Absolute Temperature Scale
7.4- Thermal Expansion and of Solids and Liquids
7.5- The Unusual Behavior of Water
7.6- Macroscopic Description of an Ideal Gas

8- Energy and Energy Transfer

8.1- Work Done by Constant Force
8.2- The Scalar Product of Two Vectors
8.3- Work Done by Varying Force
8.4- Work DONE by a Spring
8.5- Kinetic Energy and the Work-Kinetic Energy Theorem
8.6- Conservations of Energy
8.7- Situations Involving Kinetic Energy
8.8- Power
8.9- Energy and the Automobile

Physics Lab.1

This is the Lab-based course covering the subject matter of PHY 109 .The course presents an introduction to the methods of experimental physics Emphasis is on developing student's skills in experimental techniques, data analysis, and scientific reporting of lab work. During the course students execute a series of experiments on Kinematics of motion, kinetic and potential energy, Oscillatory motion, Thermal properties of matter, and Viscosity. The course includes computer based experiments on Classical Mechanic

Lab. Section

Mechanical Physics Experiments

1- Determination the Density of Solid Materials
2- Verification of Hooks Law
3- Determination the Value of Gravity Acceleration (Simple Pendulum)
4- Determination the Coefficient of Viscosity
5- Measurement of Liquid Density
6- Verification of Newton's Second Law
7- Verification of continuity Equation
8- Determination the Mechanical Equivalent of Heat
9- Determination the Specific Heat Capacity of a Solid

Program and Course Outcomes:
Students will learn:

1. Describe the translational motion of a single particle in terms of position and inertial frames, inertia, velocity, acceleration, linear momentum and force.
2. Describe the rotational motion of a rigid body using the concepts of rotation angle, angular velocity, angular acceleration, angular momentum, moment of inertia, and torque.
3. Identify the forces acting on ordinary mechanical systems to be gravity and electromagnetics (Drag force, frictional force, normal force, etc.).
4. State the fundamental laws of kinematics and dynamics of rotational motion of a rigid body and use them to solve problems on simple rotational motion.
5. Analyse the translational and rotational motion using a scalar approach based on the concepts of work, conservative and non-conservative forces, potential energy and conservation of mechanical energy.
6. State the two conditions of static and dynamic equilibrium of a point particle and a rigid body, and use them to solve problems of static equilibrium.
7. Define and calculate the following parameters of oscillatory and wave motion: amplitude, period, frequency, angular frequency, speed of a wave, energy transported, Power and intensity;
8. Describe Simple Harmonic Motion qualitatively and quantitatively.
9. Recognize and analyse some wave characteristics: principle of superposition, interference, diffraction, reflection, transmission, refraction, standing waves and Resonance.
10. Define what is meant by: temperature, specific and molar heats of capacity.

Recommended Textbook(s):

R.D. Knight, Physics for Scientists and Engineers, 2nd ed., Pearson 2008

ME 1203 – Chemistry (4-3-0-2)

Prerequisites:

ME 1201 Calculus I

Course Description

Chemistry and Measurement and significant figures. Atoms, molecules and ions. Formulas and names. Stoichiometry and chemical calculations. Chemical reactions. Thermochemistry and enthalpy changes. Quantum theory of the atom and electron configuration. Chemical bonding and molecular geometry. The Lab. Section presents Safety in the Lab. Measurement of mass, volume and density. Identification of an unknown compound. Qualitative analysis of anions. Empirical formula of a compound. Thermal decomposition of hydrates. Stoichiometric determination. Acidbase and redox titrations. Enthalpy of reactions

Course Topics:

1. Measurements. Handling Numbers. Dimensional Analysis in Solving Problems Recognize chemical safety and hazardous materials icons, and apply laboratory safety rules.
2. Atomic Number, Mass Number, and Isotopes. The Periodic Table. Molecules and Ions.
   Describe laboratory instruments and some basic techniques used in the chemistry laboratory, including balances and standard volumetric equipment.
3. Chemical Formulas. Naming Compounds. Atomic Mass. Avogadro's number and Molar Mass of an Element.
   Describe and use UV/VIS spectrophotometric methods of analysis.
4. Molecular Mass. The Mass Spectrometer. Percent Composition of Compounds. Experimental Determination of Empirical Formulas. Chemical Reactions and Chemical Equations.
   Describe how to Prepare accurate laboratory reports of their experimental results.
5. Amounts of Reactants and Products. Limiting Reagent Calculations. Reaction Yield.
6. General Properties of Aqueous Solutions. Precipitation Reactions. Acid-Base Reactions. Oxidation-Reduction Reactions.
7. Concentration of Solutions. Acid-Base Titrations. Gases. Pressure.
8. The Ideal Gas Equation. Gas Stoichiometry. Partial Pressures
9. The Nature of Energy and Types of Energy. Energy Changes in Chemical Reactions. Introduction to Thermodynamics.
10. Enthalpy of Chemical Reactions. Calorimetry. Standard Enthalpy of Formation and Reaction.
11. From Classical Physics to Quantum Theory. Bohr's Theory of the Hydrogen Atom. Quantum Numbers. Atomic Orbitals.

12 Electron Configuration.
Development of the Periodic Table. Periodic Classification of the Elements.
Periodic Variation in Physical Properties.

13 Ionization Energy. Electron Affinity
Lewis Dot Symbols. The Ionic Bond. The Covalent Bond. Electro negativity.
Writing LewisStructures. Formal Charge and Lewis Structures.

14 The Concept of Resonance. Exceptions to the Octet Rule.
Bond Energy. Molecular Geometry. Dipole Moment.
Spectrophotometric Analysis of tetracycline

15 Valence Bond Theory.
Hybridization of Atomic Orbital's. Hybridization in Molecules
Containing Double and Triple Bonds. Delocalized Molecular Orbital's.

Lab. Section

1. Safety, Lab Check-in

Mass and Volume Measurements.

2. Qualitative Analysis of Anions : Part I

3. Qualitative Analysis of Anions : Part II

4. The Empirical Formula of a Metal Oxide

5. Volumetric Analysis: Standardization of Sodium Hydroxide and Determination of Molar Mass of an Acid 6. Applications of Volumetric Analysis: Determination of Active Ingredients of Commercial Bleach and Vinegar.

7. Evaluation of the Universal Gas Constant, R

8. Heat of Formation of Magnesium Oxide

9. UV/VIS Spectroscopy and Spectrophotometry

10. Spectrophotometric Analysis of Aspirin

11. Synthesis of Alum and Crystal Growth

Course Learning Outcomes:

Upon the successful completion of this course, students will be able to:

1. Define the structure of the atom in terms of the nucleus with protons and neutrons, and electrons.

2. Write and balance chemical equations, name inorganic compounds and ions and describe the properties of the main group elements.

3. Carry out chemical calculations, including mass relations in chemical reactions, limiting reagent and reaction yield calculations, and calculations involving reactions taking place in solution.

4. Understand the concept of oxidation-reduction, calculate oxidation numbers, and balance redox reactions.

5. Apply the ideal gas law in solving problems involving the gas phase.

6. Solve problems in chemical thermodynamics and calorimetry.

7. Predict the electronic structure of atoms and ions from quantum theory, and9) relate the position of an element in the periodic table to its electronic structure and to the physical and chemical properties of the elements.

8. Describe the principles of chemical bonding and write Lewis structures

9. Predict the geometry of the electron pairs and the shape of molecules using VSEPR theory, predict bond polarity and molecular dipoles

10. Describe the valence bond theory, predict the hybridization of atoms in molecules, and describe bonding in molecules with single, double and triple bonds in terms of and bonds, and delocalized molecular orbitals

Recommended Textbook(s):

Chang R. & College W.,Chemistry, McGraw Hill 9th ed., 2007

ME 1204 – Computer science (3-2-1-2)

Prerequisites:

None

Course Description

This course introduces the student to computer concepts, control structures, functions, and arrays:single and multidimensional, and string processing found in Visual Basic. The course also examines input/output statements including data file I/O, arithmetic, logical and comparison operators, along with an introduction to classes.

Course Topics:

1. Computer Fundamentals and safety
2. Computer Components
3. Operation system

4. Introduction to MS-Word
5. Insert objects in MS-Word
6. Additional tasks in MS-Word
7. Introduction to MS-Power Point
8. Introduction to MS-Excel

Course Description:

This course introduces the student to computer fundamentals-related issues such as chronological development of computers, computer main features, types of computers, computer components (input and output devices). In addition, this course introduces students to the computer safety-related issues and the required skills to deal with operating system. This course will also help students to have the required skills to produce an efficient Word documents. Finally, skills related to production effective presentation using Microsoft power point is also covered during this course.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Identify development of computers, type and features,(input and output devices) , various risks of computers (viruses, malware, adware, etc.) and how to deal with operating system of computers.
2. How to deal with Microsoft Word to produce an effective document (various tabs, commands, and advanced skills).
3. Skill of using Microsoft PowerPoint to produce effective presentations.
4. Work productively with peers as a member of an engineering team to implement a project.

Recommended Textbook(s):

Byron S. Gottfried, Theory and Problems of Programming with Visual Basic, Schaum's Outline Series McGraw-Hill, Inc., 2001

ME 1205 – Engineering Mechanics I (Static) (3-3-1-0)

Semester Offered

Spring semester

Prerequisites

ME 1202 Physics

Course Definition

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses you have taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving.

Course Topics:

1. **General Principles:** Fundamental concepts, units of measurement, force vectors: force system resultants: moment of a force, moment of a couple, addition of a system of coplanar forces.
2. **Equilibrium of a Particle**: Condition for the equilibrium of a particle, free-body diagram and three-dimensional force systems.
3. **Equilibrium of a Rigid Body**: Conditions for rigid-body equilibrium, support reactions.
4. **Structure Analysis:** Simple trusses, the method of joints, zero-force members, the method of sections, frames and machines.
5. **Center of Gravity and Centroid:** Center of Gravity, Center of Mass, and the Centroid of a Body
6. **Moments of Inertia:** Definition of moments of inertia for areas, and parallel-axis theorem for an area.
7. **Friction:** Characteristics of dry friction, problems involving dry friction, and frictional forces on flat belts.

Course Objectives

The Objectives of this course are to enable students to:

1. Understand the differentiate between a random process and a deterministic process.

2. Solve probability problems and its applications by to determine the sampled data; analyze it graphically.
3. Understand the relationship between both discrete and continuous random variables.
4. Understand the theoretical of the normal distribution with many populations in practice.
5. Learn statistical hypotheses by carrying statistical tests, using different significance levels.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. To understand the principles of mechanics to determine resultant forces of a system in rectangular or nonrectangular coordinates
2. To construct free-body diagrams and identify their appropriate equilibrium equations in terms of reaction forces in a frame structure and the connection forces in trusses.
3. An ability to analyse systems that include frictional forces.
4. An ability to locate centroid of an area and calculate second moments of inertia.

Recommended Textbooks

- ✓ R. C. Hibbeler, "Engineering Mechanics - Statics " 13th Edition, 2012
- ✓ J.L Meriam and L.G. Kraige (2016) Engineering mechanics statics
- ✓ Higden , A, stiles W.B. & davis , A.W. Engineering mechanics statics and dynamics 1968 .

ME 1206 - Fundamentals of Electrical Engineering (3- 2- 1- 2)

Prerequisites:

ME 1201 Calculus -1

Course Definition

This course introduces the basics of electric circuits, series and parallel connection, and DC circuit analysis. Additionally, the course presents ohms law, Kirchhoff laws for solving series parallel circuits. Furthermore, it introduces circuit theorem and their analysis; including mesh, nodal, and superposition theorems. Thevenin and Norton theorems are also included. Finally, the course introduces capacitors and inductor into the circuit and how to deal with it under dc condition.

Course Topics:

1. Introduction to electrical engineering
2. Charge, current, and voltage
3. Ohms law
4. Kirchhoff laws
5. Star delta analysis
6. Nodal analysis
7. Mesh analysis
8. Source transformation
9. Superposition theorem
10. Thevenin circuits
11. Norton circuits
12. Capacitor C
13. Inductor L
14. Circuit analysis including R, L, and C

Course Description

Electrical engineering is a professional engineering discipline that generally deals with the study and application of electricity, electronics, and electromagnetism. In electrical engineering, we are often interested in communicating or transferring energy from one point to another. To do this requires an interconnection of electrical devices. Such interconnection is referred to as an electric circuit, and each component of the circuit is known as an element.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Understand the basic concept of electrical circuits.
2. Solve series and parallel DC circuits.
3. Apply Methods of Analysis and Circuit Theorems to solve DC circuits.
4. Solve series/parallel circuits with capacitors and inductors.

Laboratory

1 Introduction to the LAB
2 Ohm's law
3 Kirchhoff's current and voltage law

4 series-parallel network
5 Superposition theorem
6 Thevenin's theorem
7 Norton's theorem
8 LAB final exam

Recommended Textbook(s):

- Alexander and Sadiku "Fundamentals of Electric Circuits" Third Edition McGraw Hill.
- Boyles tad, R. L., Introductory Circuit Analysis (10th Edition).

ME 1207 – Calculus-II (3-3-1-0)

Prerequisites:

ME 1201 Calculus -I

Course Definition

This course provides a comprehensive guide and up-to-date treatment of engineering mathematics with an in-depth overview of the many mathematical. It is intended to introduce students of engineering, physics, mathematics, computer science, and related fields to those areas of applied mathematics that are most relevant for solving practical problems.

Course Topics:

1. Fundamentals of Integrals
2. Definite and indefinite integrals
3. Integration Techniques -Integration by Parts.
4. Integration Techniques- Trigonometric Integrals.
5. Integration Techniques- Partial Fractions.
6. Applications of Integrals- Arc Length and Surface area
7. Applications of Integrals- Volumes (Disk, Washer, Shell)
8. Polar Coordinates - Common Polar Coordinate Graphs.
9. Polar Coordinates - Tangents with Polar Coordinates, Curves defined by parametric equations.
10. Sequences and Series.

Course Description:

Transcendental functions. Techniques of integration. Sequences and Infinite series. Parametric equations and polar coordinates

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Evaluate of definite, indefinite and improper integrals by using different integration techniques.
2. To determine arc length, surface area and volume by using the applications of integration techniques.
3. Define polar coordinate graphs and solve related problems including area, arc length and volume.
4. Identify the properties of sequences and their limits with identifying standard convergent operations of power series.

Recommended Textbook(s):

1. Stewart, J., Clegg, D. K., & Watson, S. (2020). Calculus: early transcendentals. Cengage Learning.

2. Thomas, G. B., Haas, J., Heil, C., & Weir, M. (2018). Thomas' Calculus. Pearson Education Limited.

3. Kreyszig, E., Stroud, K. and Stephenson, G., 2008. Advanced engineering mathematics. Integration, 9(4).

ME 1208 – Engineering Drawing (3-2-2-2)

Prerequisites:

None

Course Definition

This course discusses the fundamental concepts of engineering graphics. It gives also an introduction to computer graphics using CAD software. The following topics are covered: Drawing conventions such as standards, line types and dimensioning; drawing of inclined and

curved surfaces; deducting the orthographic views from a pictorial; drawing full and half sections; deducting an orthographic view from given two views; pictorial sketching (isometric and oblique).

Course Topics

- Introduction: graphic language, standards, instruments, letters…etc.
- Basics for interpreting drawings, line types, types of drawings and sketches
- Orthographic views. Deducing front, top, and side views from a pictorial Dimensioning
- Sectional views: full and half sections
- Drawing a missed view from given two

Course Description:

This course discusses the fundamental concepts of engineering graphics. It gives also an introduction to computer graphics using CAD software. The following topics are covered: Drawing conventions such as standards, line types and dimensioning; drawing of inclined and curved surfaces; deducting the orthographic views from a pictorial; drawing full and half sections; deducting an orthographic view from given two views; pictorial sketching (isometric and oblique).

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

- Recognize the value of engineering graphics as a language of communication.
- Infer the nature of engineering graphics, the relationships between 2D and 3D environments.
- Comprehend and deduce orthographic projections of an object.
- Visualize wide variety of objects and drawing the missing views.
- Comprehend and deduce section views.
- Produce three dimensional drawings utilizing CAD software.

Recommended Textbook(s):

Interpreting Engineering Drawings, Jensen, C.H. and Helsel, G.D., 7th ed., Thomson Delmar Learning, 2007

ME 2201 – Calculus-III (3-3-1-0)

Prerequisites:

ME 1207 – Calculus-II

Course Definition

Advanced topics in calculus, including vectors and vector-valued functions, partial differentiation, Lagrange multipliers, multiple integrals, and Jacobians; application of the line integral, including Green's Theorem, the Divergence Theorem, and Stokes' Theorem.

Course Topics:

1- Vectors and the Geometry of Space Three-Dimensional Coordinate Systems
Vectors
The Dot Product
The Cross Product
Lines and Planes in Space
Cylinders and Quadric Surfaces

2- Vector-Valued Functions and Motion in Space
Curves in Space and Their Tangents
Integrals of Vector Functions; Projectile Motion
Arc Length in Space
Curvature and Normal Vectors of a Curve
Tangential and Normal Components of Acceleration

3- Partial Derivatives
Functions of Several Variables
Limits and Continuity in Higher Dimensions
Partial Derivatives
The Chain Rule
Directional Derivatives and Gradient Vectors
Tangent Planes and Differentials Extreme Values and Saddle Points Lagrange Multipliers

4- Multiple Integrals
Double and Iterated Integrals over Rectangles
Double Integrals over General Regions
Area by Double Integration
Triple Integrals in Rectangular Coordinates

5- Integration in Vector Fields (Vector Analysis) Vector Fields and Line Integrals
Green's Theorem in the Plane
Stokes' Theorem
The Divergence Theorem and a Unified Theory

Course Description

Calculus III course includes three major topics which are vectors, partial derivatives and differential equations. The Vectors mainly focuses on how to find the equation of lines and planes in space. The partial derivatives chapter focuses how to drive partially when the function has more than one independent variables. The differential equations chapter describes the general forms of the differential equations and how to solve them.

Course Learning Outcomes (CLO):

By the end of successful completion of this course, the student will be able to:

1. Perform calculus operations on vector-valued functions, including derivatives, integrals curvature, displacement, velocity, acceleration, and torsion.
2. Perform calculus operations on functions of several variables, including partial derivatives, directional derivatives, and multiple integrals.
3. Find extrema and tangent planes.
4. Solve problems using the Fundamental Theorem of Line Integrals, Green's Theorem, The Divergence Theorem and Stokes' Theorem.
5. Apply the computational and conceptual principles to the solutions of real-world problems.

Recommended Textbook(s):

1. Thomas' Calculus Early Transcendentals 12th Edition.by George B. Thomas Jr. (Author), Maurice D. Weir (Author), Joel R. Hass (Author).
2. Calculus, by H. Anton, I. Bivens, and S. Davis, 8th Edition, 2002, Wiley

ME 2202 – Calculus-IV (3-3-1-0)

Prerequisites:

ME 2201 – Calculus-III

Course Definition

Differential Equations, begins with some definitions and terminology and mathematical models used in a differential equations course. First-order and higher-order differential equations, along with the methods of solutions and their applications are introduced. Modeling with higher-order, Laplace transform, and systems of linear first-order differential equations are covered. At the end, students learn series solutions of linear equations.

Numerical methods are covered throughout the course. This course focuses on differential equations and their applications in science and engineering.

Course Topics:

1. Ordinary differential Equations

Classify differential equations by order, linearity, and homogeneity

2. First order linear differential equations
use separation of variables to solve differential equations solve exact differential equations use variation of parameters to solve differential equations solve first order linear differential equations
Bernoulli equation
Application of first Order Differential Equations
3. Higher order Differential Equations

Solutions of Homogeneous Linear D.E with constant coefficients
Solutions of Inhomogeneous Linear D.E with constant coefficients

The Method of Undetermined Coefficients
Method of Variation of Parameters

The Euler-Cauchy Differential Equations
Reduction of Order

Applications of Higher Order Differential Equations
4. Simultaneous Linear Differential Equations

Elimination of dependent variables by differentiation
Elimination of dependent variables using operator equation

Solution by Cramer rule
5. Fourier series

Periodic functions
Trigonometric series Bounds of a Function Continuity of a Function Euler Coefficients

Even and Odd Functions Half Range Expansion Applications
6. Laplace Transforms
Properties of Laplace Transforms

Inverse of Laplace transforms
Solution of Ordinary D.E's by Laplace transforms

D.E's with constant coefficients
D.E's with variable coefficients:

Solution of Simultaneous Linear D.E's by Laplace transforms

Course Description

Multiple Integrals (double and triple integrals). Laplace transforms and Inverse Laplace transforms. Systems of linear differential equations. Series solutions. Partial differential equations.

Course Objectives

1. Recognize double integrals over the rectangle and non-rectangle regions.
2. Determine transformation of a double integral, solve double integral in polar form and identify triple integral.
3. Identify the main definitions and properties of Laplace and inverse Laplace transforms.
4. Discover rules of partial fractions and special functions.
5. Determine system of Linear Differential Equations and solving systems by Laplace transforms.
6. Discover and use Series Solutions.
7. Format and solve Partial Differential Equations.

Students Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Classify differential equations by order, linearity, and homogeneity
2. Solve first order linear differential equations
3. Solve linear equations with constant coefficients
4. Use separation of variables to solve differential equations
5. Solve exact differential equations
6. Use variation of parameters to solve differential equations
7. Use the method of undetermined coefficients to solve differential equations
8. Determine whether a system of functions is linearly independent using the Wronksian
9. Model real-life applications using differential equations
10. Use power series to solve differential equations
11. Use Laplace transforms and their inverses to solve differential equations
12. Solve systems of linear differential equations using matrix techniques and eigenvalues
13. Use numerical methods to solve differential equations

Recommended Textbook(s):

• Differential Equations with Boundary-Value Problems, seventh edition. Dennis G. Zill, Michael R Cullen. Copyright 2009, Brooks/Cole. ISBN-13: 978-0-495-10836-8

• Differential Equations with Boundary-Value Problems Student Solutions Manual. Warren S. Wright, Dennis G. Zill, Carol D. Wright. Copyright 2009, Brooks/Cole Publishing Company. ISBN 978-0-495-38316-1.

ME 3201- Engineering Statistics (3-3-0-0)

Prerequisites

ME 2202 Calculus-IV

Course Definition

Statistical Engineering models are based on mathematics and probability theory. This course provides students with a working knowledge of fundamental statistics principles and probability in addition to a preface to the regression and correlation analysis. By the end of the semester, students should be able to determine when each of the various topics we have covered is appropriate to use, and to apply them to practical engineering situations or problems. This course will cover techniques on data collection and presentation, descriptive statistics, basic elements of probability theory, sampling techniques and theory, statistical estimation, hypothesis testing and regression analysis.

Course Topics:

Fundamentals (Introduction to Statistics)

1. Introduction
2. Descriptive and Inferential Statistics
3. Variables and Types of Data
4. Data Collection and Sampling Techniques
5. Observational and Experimental Studies

Presentation of a Statistical Data

1. Introduction
2. Organizing Data
3. Grouped Frequency Distributions or Frequency Distributions Table
4. Graphs: Histograms, Frequency Polygons, and Ogive
5. Other Types of Graphs

Data Description

1. Measures of Central Tendency (Mean, Median and Mode)

2. Measures of Variation
   2.1. Population Variance and Standard Deviation
   2.2. Sample Variance and Standard Deviation
   2.3. Variance and Standard Deviation for Tabulated Data
   2.4. Range
3. Coefficient of Variation

Probability and Counting Rules

1. Sample Spaces and Probability
2. Tree diagram
3. Basic Probability Rules
4. Venn Diagram
5. The Addition Rules for Probability
6. The Multiplication Rules and Conditional Probability
7. Conditional Probability
8. Counting Rules
   8.1. Permutations
   8.2. Combinations
9. Probability and Counting Rules

Discrete Probability Distributions

1. Probability Distributions
2. Mean, Variance, Standard an Deviation
3. The Binomial Distribution
4. The Poisson Distribution

Continuous Probability Distributions

The Normal Distribution

1. Normal Distributions
2. Applications of the Normal Distribution
3. Normal Distributions Formula
4. The Standard Normal Distribution
5. Finding Areas Under the Standard Normal Distribution Curve (Table Method)
6. A Normal Distribution Curve as a Probability Distribution Curve
7. Applications of the Normal Distribution
8. Determining Normality
9. The Normal Distribution Approximation to the Binomial Distribution

Confidence Intervals and Sample Size

1. Preface
2. Confidence Intervals for the Mean When σ is Known
   2.1. A point estimate
   2.2. An interval estimate
   2.3. Confidence Intervals
3. Sample Size
4. t-Distribution

3. Confidence Intervals for the Mean When σ is Unknown
4. The chi-square Distribution
5. Confidence Intervals for Variances and Standard Deviations
   5.1. Confidence Interval for a Variance
   5.2. Confidence Interval for a Standard Deviation

Hypothesis Testing

1. Preface
2. Steps in Hypothesis Testing—Traditional Method
   2.1. The null hypothesis (H_0)
   2.2. The alternative hypothesis (H_1)
   2.3. The level of significance
3. *z* Test for a Mean
4. P-Value Method for Hypothesis Testing
5. t Test for a Mean
6. z Test for a Proportion
7. X^2 Test for a Variance or Standard Deviation

Testing the Difference Between Two Means, Two Proportions, and Two Variances

1. Preface
2. Testing the Difference Between Two Means: Using the z Test
3. Testing the Difference Between Two Means of Independent Samples: Using the tTest
4. Testing the Difference Between Two Means: Dependent Samples
5. Testing the Difference Between Two Variances

Correlation and Regression

1. Preface
2. Scatter Plots and Correlation
3. Regression
4. Coefficient of Determination and Standard Error of the Estimate.

Course Description:

Classification of Data. Graphical representation. Arithmetical description. Probability theory, probability of an event and composite events. Addition rule and multiplication rule, independent events. Counting techniques. Random variables and probability distributions. Expected values. Continuous and discrete random variables. Normal distribution. Binomial distribution. Poisson distribution. Joint and marginal probability distributions. Independence of random variables. Covariance and correlation. Random sampling. Unbiased estimates. Statistical intervals and test of hypothesis for a single sample.

Course Objectives

The Objectives of this course are to enable students to:

1. Understand the differentiate between a random process and a deterministic process.
2. Solve probability problems and its applications by to determine the sampled data; analyze it graphically.
3. Understand the relationship between both discrete and continuous random variables.
4. Understand the theoretical of the normal distribution with many populations in practice.
5. Learn statistical hypotheses by carrying statistical tests, using different significance levels.

Course Learning Outcomes

On completion of this course, the student should be able to:

1. use a number of methods and techniques for collecting and presentation the sets of data.
2. calculation and demonstration the center tendency and variation of data.
3. compute the probabilities in a simple cases and using the rules of probability in computing;
4. give an account of the concept random variable and be able to use some common probability distributions;
5. understand the meaning of the central limit theorem;
6. use point and interval estimates for some typical statistical problems;
7. apply elementary regression for fitting measured data.

Recommended Textbooks

1. Elementary Statistics A Step by Step Approach, Eighth Edition, By Allan G. Bluman.
2. Probability and Statistics For Engineers and Scientists, Fourth Edition, By Sheldon Ross.

ME 3202 – Engineering Numerical Methods (3-2-1-2)

Prerequisites:

ME 1204 Computer Science

ME 2202 Calculus-IV

Course Description

In numerical analysis one explores how mathematical problems can be analyzed and solved with a computer. As such, numerical analysis has very broad applications in mathematics, physics, engineering fiancé, and the life sciences. This course gives an introduction to this subject for mathematics majors. Theory and practical examples using Matlab will be

combined to study a range of topics ranging from simple root-finding procedures to differential equations and finite element method.

Course Topics:

Part-I: Basic Tools

Unit-1: Error Analysis

- Measuring Errors
- Sources of Error
- Consistency, Order, Smoothness and Convergence

Unit-2: Roots of equations (**Nonlinear Equations)**

- Bisection Method
- False-Position Method (Optional)
- Newton-Raphson Method
- Secant Method (Optional)

Unit-3: Simultaneous Linear algebraic Equations

- Direct Methods

- Review of Determinants and Matrices
- Cramer's Rule
- Gauss-Elimination method (simple and partial pivoting methods)
- Gauss-Jordan Method
- Matrix Inversion method

- Indirect (Iterative) Method

- Jacobi Method
- Gauss-Seidel Method
- Successive Over-Relaxation Method

Unit-4: Numerical Differentiation and Integration

- Numerical differentiation using difference method
- Numerical Integration, Trapezoid and Simpson's Rules
- Extrapolation of Errors

Unit-5: Interpolation and Curve Fitting

- Direct Fit Polynomial
- Least Squares Method
- Logarithmic regression (Optional)
- Exponential regression (Optional)
- Linear interpolation , Quadratic Interpolation
- Lagrange Interpolation (Optional)
- Newton Divided Difference Interpolation (Optional)

Part-II: Numerical Solutions of Ordinary Differential Equations

Unit-6: Initial Value Problem

- Euler's Method
- Runge-Kutta 2nd
- Runge-Kutta 4th
- Higher Order Equations

Unit-7: Boundary Value Problem

- Equilibrium (Finite Difference) Method

Part-III: Numerical Solutions of Partial Differential Equations
Unit-8: PDEs

- Elliptic Equations
- Parabolic Equations
- Hi-parabolic Equations
- Advanced Application (Case Studies based on each department interests).

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. find roots of functions by using a range of methods

2. solve systems of linear and non-linear and non-linear algebraic equations by using a range of methods

3. apply numerical interpolation, differentiation, integration and solving engineering problem

4. use techniques for solving ordinary differential equations

5. Use MATLAB or other numerical tools for solving problems by numerical methods.

Recommended Textbook(s):

Numerical Methods for Engineers, S. C. Chapra and R. P Canale, McGraw-Hill, 6th edition 2010.

DEPARTMENT REQUIREMENT COURSES

First Year (Freshman Level)

ME 1301 – Principles of Manufacturing Process (3-2-1-2)

Semester Offered (Fall – Spring)

Spring semester

Prerequisites

None

Course Definition

Studying the basic principles of industrial safety and metal extraction .and manufacturing processing.

Course Topics

- ✓ Engineering materials
- ✓ introduction to entrepreneurship,
- ✓ Manufacturing processes: casting, welding, forming, working ,joining processes.
- ✓ Hand work and hand tools,
- ✓ Concept of machining processes, turning, drilling milling, and grinding.
- ✓ Metrological concepts.
- ✓ Industrial safety.
- ✓ Engineering materials
- ✓ introduction to entrepreneurship,
- ✓ Manufacturing processes: casting, welding, forming, working ,joining processes.
- ✓ Hand work and hand tools,
- ✓ Concept of machining processes, turning, drilling milling, and grinding.
- ✓ Turning process
- ✓ Milling process

Course Description

Materials engineering, physical properties and mechanical testing mechanical, industrial safety, measuring instruments, allowances and excesses, the production of metallic materials (ferrous and nonferrous), manufacturing operations, basic - plumbing, composition, hot, cold forming, manufacturing processes Secondary - welding, arrived metals , powder technology, operating Absolutely.

Course Objectives:

The goals of this course are to enable students to:

1. Students should understand of the principles of the major manufacturing processes.
2. Students should be able to recognize the standard processes used to produce products
3. Students should be able to select the optimal process to produce a product.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. To understand the principle of manufacturing engineering.
2. To obtain important information about the iron ores and how can obtain the different types of iron and steel.
3. To classify materials and their improvement properties.
4. To know the different types of machining processes.

Recommended Textbook(s)

1. Rajender Singh third Edition 2006 Introduction to manufacturing process and Workshop Technology

2. Fundamentals of Modern Manufacturing by Groover

3. Manufacturing Engineering and Technology by Kalpakjian

4. Materials and Processes in Manufacturing by E.P Degarmo

5. Process and Materials of manufacture by F.A Lindberg.

Lab Topics

Non

ME 1302 - Applied Physics (2-2-1-0)

Semester Offered (Fall – Spring)
Spring semester

Prerequisites

ME 1202 Physics

Course Definition

Applied physics is the application of physics to solve scientific or engineering problems. It is usually considered to be a bridge or a connection between physics and engineering.

Course Topics

- ✓ Electric charge; Coulomb's law
- ✓ Electric field; Electric field lines
- ✓ Electric dipole field and Gauss's law.
- ✓ Electrostatics: Electric charge; Coulomb's law.
- ✓ Capacitors and their capacitance.
- ✓ Capacitors in series and in parallel; Energy stored in a capacitor.
- ✓ Current; resistance and Voltage.
- ✓ Ohm's law; Resistivity; Conductivity.
- ✓ Gauss's law in magnetism.
- ✓ Lorentz's force law; Force on a current carrying wire.
- ✓ Magnetic field; Ampere's law; magnetic flux.
- ✓ AC voltage and current.
- ✓ Simple Ac circuits and applications.
- ✓ Impedance and phases.

Course Description:

This course is designed to meet the needs of student majoring in Engineering. The course is a survey of the concepts, principles, methods and major findings of applied physics, which is a continuation of the survey of principles of classical physics presented in course (ME 1202). Topics will be addressed in this course including: Electrostatics, Electric charge and electric field, Coulomb's law, electric potentials, Capacitance and dielectric, currents, Resistance

Ohm's law, Electromotive force, Direct current circuits, magnetism, Magnetic field and magnetic forces, Sources of magnetic field, and Ampere's law, induction, Faraday's Law, Maxwell's equations, electromagnetic radiation, wave motion, and physical and geometrical optics.

Course Objectives:

The general goals of applied physics course is to provide an introduction to the applied physical concepts that will be related with Mechanical Engineering subjects as well as in their professional applications. The main course objectives are as follows:

1) The ability to identify, formulate, and basic for electrostatic and electromagnetic solve in apply physics problems.
2) The ability to formulate, conduct, analyze, and interpret for electrostatic and electromagnetic in apply physics.
3) Working knowledge of fundamental physics and basic electrostatic and electromagnetic in Mechanical engineering principles to involve combined knowledge in one or more engineering disciplines.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1) Define and calculate the basic physical quantities of electrostatics and electromagnetic for the case of simple static charge distribution.
2) Understand the equipotential lines of electric potential for various simple charge configurations.
3) Represent and Draw the electric and magnetic field graphically for various charge distributions.

Text Book(s):

D. Knight, Physics for Scientists and Engineers, 2nd Edition., Pearson 2008

Recommended Readings:

1. Raymond A. Serway and John W. Jewett " Physics for Scientists and Engineers with Modern Physics".
2. Hans C. O. , and John T. Markert, "Physics for Engineers and Scientists", 3rd Edition.

Second Year (Sophomore Level)

ME2301 - Fluid Mechanics-I (3-2-1-2)

Semester Offered

Fall semester

Prerequisites

ME 1207 Calculus-II

ME 1202 Physics

ME1205 Engineering Mechanics I (Static)

Course Definition

Fluid mechanics is a branch of physics concerned with the mechanics of fluids, which involves liquids and gases, and the forces on them. Fluid mechanics is defined as the science that deals with the behaviour of fluids at rest (fluid statics) or in motion (fluid dynamics), and the interaction of fluids with solids or other fluids at the boundaries. Fluid mechanics is also referred to as fluid dynamics by considering fluids at rest as a special case of motion with zero velocity.

Course Topics

The topics that will cover in this course will be:

1. Properties of Fluids
2. Hydrostatic Fluids
3. The mass, Bernoulli, energy equations and momentum analysis of flow systems
4. Dimensional Analysis and Modeling
5. Laminar flow through Pipes

Course Description

This course covers basic criteria of the concept of a fluid, the fluid as a Continuum, Dimensions and Units. Fluid properties are also addressed here including density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid,

hydrostatic law-Pressure head, Pascal's law. Measurement of pressure: piezometric tube, manometer. Hydrostatic pressure distributions, hydrostatic forces on plane surfaces, hydrostatic forces on curved surfaces, buoyancy and stability, pressure distribution in rigid-body motion. Mass and volume flow rates, Bernoulli's equation: derivation of the Bernoulli equation. Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis-Buckingham Pi theorem. Model analysis: Advantages and applications of model testing, similitude, derivations of important dimensionless numbers. Reynolds number regimes, Laminar and turbulent flow characteristics, laminar flow through circular and non- circular pipes, pipe flow friction factor (Darcy-Weisbach equation). Pipe-flow problems.

Course Objectives

1. To understand the properties of the fluid.
2. To understand hydrostatic forces on submerged plane surfaces.
3. To understand mass, Bernoulli, momentum analysis of flow systems and energy equations.
4. To understand the principle of dimensional homogeneity and dimensional analysis and modelling.
5. To understand the laminar flow regime in circular and non-circular pipes.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Characterize, define and explain fundamental concepts of fluid mechanics including: continuum, density, specific weight, viscosity, surface tension and capillary effect.
2. Derive, analyze and discuss the basic equation of static fluid to determine hydrostatic forces on submerged planar and curved surfaces, manometers and fluids in rigid-body motion.
3. Analyze and comprehend the mass, Bernoulli, momentum analysis of flow systems and energy equations.
4. Review the concepts of dimensions and units, analyze and discuss the dimensional analysis and modeling.
5. Perform and understand the viscous laminar flow regime through circular and non-circular pipes.

Lab Experiments:

1. Calibration of pressure measurement device (Bourdon Gauge)
2. Determination of pressure center of a surface embedded completely or partially in a liquid.
3. Osborne Reynolds' demonstration (Determination of Reynolds number).

Recommended Textbooks

1- Frank M. White, "*Fluid Mechanics*", WCB McGraw-Hill series in mechanical engineering, Fourth Edition, 2012.

2- Yunus A. Çengel and John M. Cimbala, "*Fluid Mechanics: Fundamentals and Applications*", McGraw-Hill series in mechanical engineering, First Edition, 2006.

3- Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, and Wade W.Huebsch, "*Fundamentals of Fluid Mechanics*", John Wiley & Sons, 6th Edition, 2009.

4- Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, "*Fluid Mechanics*", McGraw-Hill, 9th Edition, 2002.

ME 2302 - Strength of Materials-I (3-2-1-2)

Semester Offered

Fall semester

Prerequisites

ME 1207 Calculus-II

ME1205 Engineering Mechanics I (Static)

Course Definition

Strength of materials, also called mechanics of materials, is a subject which deals with the behavior of solid objects subject to stresses and strains. The study of strength of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts. The methods employed to predict the response of a

structure under loading and its susceptibility to various failure modes takes into account the properties of the materials; in addition the mechanical element's macroscopic properties (geometric properties.

Course Topics

1. Introduction to Strengths of Materials/Statics Review
2. Simple stresses and strains
3. Compound beams
4. Bending moments and shearing forces diagrams
5. Bending stresses in beams
6. Torsion.
7. Shear stresses in beams
8. Principal stresses and strains

Course Description

This calculus based course for Engineering students covers stresses and deformation in structural members due to axial, tensile and compressive loads, torsional loads on shafts and bending and shear loads on beams. Also included is the study of the basic design of structural members based on the analysis of stress, the deformation, and an understanding of the mechanical behavior of materials under various load conditions.

Course Objectives

1. Calculate stresses on a member subjected to axial loads
2. Calculate stresses of a member subjected to shear force
3. Explain and compute the mechanical properties of materials.
4. Calculate angular rotation of a shaft subjected to torsional moment.
5. Compute forces, stresses, and bending moments in loaded beams.
6. Evaluate combined stresses and draw Mohr's stress circle.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Understand the effect of direct and shear force on mechanical parts and the difference between these forces.

2. Drawing the shear force and bending moment diagram and solve the problems that contain bending stress and shear stress.

3. Recognize the difference between direct shear and torsion. Also, solving torsion problems in different mechanical parts.

4. Draw Mohr's stress circle and computing combine stress in different type of loading.

Lab Experiments

1. Support reaction for simply supported beams.
2. Torsion test.
3. Verification of the theory of pure bending.

Recommended Textbook(s):

1. R.C. Hibbeler, Mechanics of Materials, Prentice Hall, 7th ed., 2007.
2. E. J. HEARN, MECHANICS OF MATERIALS I, THIRD EDITION
3. Ferdinand F. Beer Mechanics of Materials, FOURTH EDITION

ME 2303 – Thermodynamics-I (3-2-1-2)

Semester Offered
Fall semester

Prerequisites

ME 1207 Calculus-II

ME 1202 Physics

ME 1203 Chemistry

Course Definition

Thermodynamics considers an important branch of physics that defines and studies the relationships between heat energy and other forms of energy, which is part of the most practical applications that serve mankind. This course provides a basic grounding in the methods and principles of applied Thermodynamics. It concentrates on: understanding the thermodynamic laws in relation to practical applications; steam and two-phase change systems, ideal gas and processes; using available sources of data such as thermodynamic tables and charts; application and operation of engine cycles.

Course Topics

1. Concepts, definitions, and basic principles
2. Thermodynamic Systems
3. Properties and State of Substance
4. Processes and Cycles
5. Forms of Energy and Reversibility
6. The Zeroth and First Laws of Thermodynamics
7. The Steady Flow and Non-Flow Energy Equations
8. Ideal gas (Single Phase System) and its laws
9. Reversible and irreversible processes
10. Steam and tow-phase Systems (Vapor)

Course Description

Fundamentals of applied thermodynamics. Systems, working substance, heat and work, state and properties, temperature scales, processes and cycles. PV diagram, Internal energy, specific heats. Ideal gas laws, equations of state, the First Law of Thermodynamics, system and control volume concept. Application of conservation of energy principle to isobaric, isochoric, isothermal, adiabatic, isentropic and polytrophic processes. Concepts, steam and two-phase system (Vapor) important terms for Steam, reversible and irreversible processes.

Course Objectives

This course is an introductory course in Thermodynamics at the undergraduate level. After successfully completing this course, students will understand how to deal essentially with the fundamentals principles of Thermodynamics including thermodynamic systems and properties, relationships between the thermal and physical properties, the various cooling and heating processes in both expansion and compression conditions, the Zeroth and First Laws of Thermodynamics and applications of these laws in various open and close thermodynamic systems. Also, students will be able to apply the principles of Thermodynamics to various fluid and heat transfer problems with some alternative solutions. This course will provide the essential knowledge and tools that are required to study Thermodynamic systems in Thermodynamics II (ME 2307).

Course Learning Outcomes

1. Characterize, define and explain fundamental thermodynamic properties, heat, work, and system.
2. Derive, analyze and discuss the forms of energy, and perform the First Laws of Thermodynamics for closed and open systems.
3. Analyze and comprehend the single-phase system and the ideal gases under various thermodynamics processes with its reversible and irreversible processes.
4. Perform and understand the two-phase problem (liquid-vapor) and analyze its processes.

Lab Experiments:

1. Temperature measurement
2. Pressure volume relationship
3. Temperature-volume-pressure relationship

Recommended Textbooks

1. SONNTAG, BORGNAKKE and VAN WYLEN" Fundamental of Thermodynamics".
2.YUNUS A. CENGEL and MICHAEL A. BOLES" Thermodynamics an Engineering Approach".
3. MERLE C. POTTER and CRAIG W. SOMERTON "Engineering thermodynamics".
4. T.D. ESTOP – A. MCCNKEY "Applied Thermodynamics".
5. RAYNER JOEL "Basic Engineering Thermodynamics".

ME 2304 - Engineering Metallurgy (3-2-1-2)

Semester Offered
Full semester

Prerequisites

ME 1301 Principles of Manufacturing Process

ME 1302 Applied Physics

Course Definition

Metallurgy is a domain of materials science and engineering that studies the effect of the solidification conditions and heat treatment on structure and properties of the materials. Moreover, its study the mechanical properties of metals, such as: the hardness, stress and strain, and creep. Metallurgical engineers develop ways of processing metals and converting them into useful products. It is also monitor metal corrosion and fatigue and develop ways to strengthen metals.

Course Topics

1. Crystal structure
2. Density computations and
3. Crystallographic points, directions, and planes
4. Alloying and solidification of metals
5. The iron–carbon system
6. Cast iron
7. Heat treatment

Course Description

The course of Engineering Metallurgy addressed structure of metals: crystalline structure of metals grains and grain boundaries, nucleation and dendritic growth, influence of solidification conditions on structure and properties. Also, it involves defection cast metals.

Course Objectives

1. To provide an understanding of the crystalline structure of metals.
2. Knowing the Iron/ Carbon phase diagram and the effect of rapid cooling,
3. To know what is the Thermal Equilibrium Diagrams?
4. To know the Heat Treatment processes, stress relieving, Annealing, full annealing, incomplete annealing, Isothermal annealing, diffusing annealing (homogenizing) annealing of casting, spherioidosing.

Course Learning Outcomes

After successful completion of this course, the students will be able to:

1. explain the basic concepts of metallurgy.

2. Understand of the crystalline structure, and relate chemical composition, structure and properties of metallic materials.
3. Adjust the structure and properties of metallic materials according to their applications.
4. Describe and understand Thermal Equilibrium Diagrams, Iron/ Carbon phase diagram and Heat Treatment processes.

Lab Experiments:

1. Learn the correct steps to check the hardness of metals.
2. Studying the effect of increasing the percentage of carbon on the mechanical properties and microstructure of steel.
3. Studying the effect of heat treatments on the mechanical properties and microstructure of steel.

Recommended Textbooks

1. The metallurgy: structure, properties and heat treatment by D. J. D. and L. A. O.
2. Materials and Processes in Manufacturing by E.P Degarmo.
3. Materials Science and Engineering An Introduction by William D. Callister, Jr..

ME 2305 - Fluid Mechanics-II (3-2-1-2)

Semester Offered

Full semester

Prerequisites

ME 2301 Fluid Mechanics-I

Course Definition

Fluid mechanics is a branch of physics concerned with the mechanics of fluids, which involves liquids and gases, and the forces on them. Fluid mechanics is defined as the science that deals with the behavior of fluids at rest (fluid statics) or in motion (fluid dynamics), and the interaction of fluids with solids or other fluids at the boundaries. Fluid mechanics is also

referred to as fluid dynamics by considering fluids at rest as a special case of motion with zero velocity.

Course Topics

The topics that will cover in this course will be:

1. Turbulent flow through pipes
2. Major and Minor Losses of flow in piping system
3. Piping Networks and Pump Selection
4. Flow Rate and Velocity Measurements
5. Flow over Bodies: Drag and lift
6. Turbomachinery: Pumps and Turbines

Course Description

Reynolds-Number Regimes, Internal versus External Viscous Flow, Semi-empirical Turbulent Shear Correlations, Flow in a Circular Pipe. Three Types of Pipe-Flow Problems, Flow in Noncircular Ducts, Minor Losses in Pipe Systems, Multiple-Pipe Systems. Minor Losses, Piping Networks and Pump Selection, Piping Systems with Pumps and Turbines. Flow Rate and Velocity Measurement, Pitot and Pitot-Static Probes, Obstruction Flowmeters: Orifice, Venturi, and Nozzle Meters, Positive Displacement Flowmeters, Turbine Flowmeters, Variable-Area Flowmeters (Rotameters). Drag and Lift, Friction and Pressure Drag, Reducing Drag by Streamlining, Flow Separation. Drag Coefficients of Common Geometries: Biological Systems and Drag, Drag Coefficients of Vehicles, Superposition, Parallel Flow over Flat Plates, Friction Coefficient, Flow over Cylinders and Spheres, Effect of Surface Roughness, Lift. Introduction and Classification, The Centrifugal Pump, Pump Performance Curves and Similarity Rule, Mixed- and Axial-Flow Pumps: The Specific Speed, Matching Pumps to System Characteristics, Turbines.

Course Objectives

1. To understand the type of laminar and turbulent flow through pipes.
2. To understand major (friction) and minor losses of flow in piping system.
3. Match pump and turbine characteristics and system characteristics to determine the duty point.
4. To understand of flow rate and velocity measurements.

5. Select the type of pump or turbine on the basis of specific speed.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Perform and understand the viscous turbulent flow through pipes and ducts.
2. Employ Bernoulli's equation for real flow and deduce expressions for orifice meter and Venturi meter, and Pitot tube (flow rate and velocity measurements).
3. Characterize and analyze the pipe losses due to friction and minor losses in pipe systems as well as multiple-pipe systems.
4. Evaluate drag and lift force for a given set of dimension and variables.
5. Introduce and classify the centrifugal pump and pump performance curve.

Lab Experiments:

1. Flow through Venturi Meter.
2. Major losses (frictional energy losses) in pipes.
3. Minor losses in pipe fittings.

Recommended Textbooks

1- Frank M. White, "*Fluid Mechanics*", WCB McGraw-Hill series in mechanical engineering, Fourth Edition, 2012.

2- Yunus A. Çengel and John M. Cimbala, "*Fluid Mechanics: Fundamentals and Applications*", McGraw-Hill series in mechanical engineering, First Edition, 2006.

3- Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, and Wade W.Huebsch, "*Fundamentals of Fluid Mechanics*", John Wiley & Sons, 6th Edition, 2009.

4- Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, "*Fluid Mechanics*", McGraw-Hill, 9th Edition, 2002.

ME 2306 - Strength of Material-II (3-2-1-2)

Semester Offered

Full semester

Prerequisites

ME 2302 Strength of Materials-I

Course Definition

Strength of materials, also called mechanics of materials, is a subject which deals with the behavior of solid objects subject to stresses and strains. The study of strength of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts. The methods employed to predict the response of a structure under loading and its susceptibility to various failure modes takes into account the properties of the materials and the mechanical element's macroscopic properties (geometric properties).

Course Topics

1. Deflection of determinate beams
2. Deflection of indeterminate beams
3. Thin cylinders
4. Thick cylinders
5. combined stress
6. Theories of failure

Course Description

Topics to be chosen from elastic and elastic-plastic behavior, plane stress and strain, constitutive relationships, principal stress and strain, failure criteria, stresses in thin, thick cylinders, bending and shearing stresses in beams, Mohr's circle, deflections of beams, Euler buckling, short and long columns, , introduction to statically indeterminacy and simple redundant structures.

Course Objectives

1. Calculate stresses in thin and thick cylinders.
2. Calculate the deflection of determinate and indeterminate beams.
3. Explain and compute the combined stresses in different loading types.
4. Explain the difference between brittle and ductile material in term of failure mode.
5. Compute the factor of safety of different loading types.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Understand the difference of stresses in thin and thick cylinders.
2. Recognize the difference between deflection of determinate and indeterminate beams..
3. Recognize the difference between the brittle and ductile material in term of failure mode.
4. Draw Mohr's stress circle and computing combine stress in different type of loading.

Lab Experiments

1. Deflection of simple supported beam
2. Deflection of cantilever beam
3. Deflection of built in beams
4. Creep test

Recommended Textbook(s):

1. R.C. Hibbeler, Mechanics of Materials, Prentice Hall, 7th ed., 2007.
2. E. J. HEARN, MECHANICS OF MATERIALS I, THIRD EDITION
3. Ferdinand F. Beer Mechanics of Materials, FOURTH EDITION

ME 2307 – Thermodynamics-II (3-2-1-2)

Semester Offered

Full semester

Prerequisites

ME 2303 Thermodynamics-I

Course Definition

Thermodynamics considers an important branch of physics that defines and studies the relationships between heat energy and other forms of energy, which is part of most practical applications that serve mankind. This course provides an introduction to the principles and applications of the Second Law of Thermodynamics. It concentrates on: understanding the thermal losses in relation to practical applications; steam and two-phase change systems, ideal gas and processes; using available sources of data such as thermodynamic tables and charts; application and operation of heat engine and heat pump cycles.

Course Topics

1. The Second Law of Thermodynamics
2. Heat Engine and Its Types
3. Refrigerators & Heat Pumps
4. Entropy Of Single Phase (Ideal Gas)
5. Entropy Of Tow Phase (Vapor)
6. Heat Engine Cycles
7. Carnot & Otto Cycles
8. Brayton & Diesel Cycles
9. Dual Cycle and Mean Effective Pressure
10. Steam Cycles (Carnot & Rankine Cycles)
11. Superheated & Reheated Rankine Cycles
12. Refrigeration System
13. Carnot Cycle
14. Refrigeration Cycles

Course Description

The Second Law of Thermodynamics definitions and formulation. Heat engines, heat pumps, thermal efficiency and coefficient of performance of reversible and irreversible engines. Concept of entropy and its application in open and closed systems, and entropy of ideal gases and vapors. Available and unavailable energy, isentropic processes, isentropic efficiency, temperature -entropy and enthalpy-entropy diagrams. Gas power cycles; Carnot cycle, Otto cycle, Diesel cycle, and Brayton cycle. Vapor power cycles; Carnot cycle, and Rankine cycle.

Course Objectives

This course is an introductory course in Thermodynamics at the undergraduate level. After successfully completing this course, students will understand how to deal essentially with the fundamentals principles of Thermodynamics including thermodynamic systems and properties, relationships between the thermal and physical properties, the various cooling and heating processes in both expansion and compression conditions, the Second Law of Thermodynamics and applications of this law in various single and two-phase cycles. Comprehend how to describe the useful systems depending on their performance. Also, students will be able to apply the principles of Thermodynamics to various fluid and heat transfer problems with some alternative solutions.

Course Learning Outcomes

1. Understand the basic concepts and principles of the Second Law of Thermodynamics.
2. To identify and formulate the entropy for single-phase (ideal gas) and two-phase(vapor) working substances.
3. Analyze and comprehend the single-phase (Air Cycles) with its reversible and irreversible processes.
4. Analyze and comprehend the two-phase (Steam Cycles) with its reversible and irreversible processes.

Lab Experiments:

1. Mechanical Heat Pump.
2. Steam and Boiling.
3. Measurement of dryness fraction of steam.

Recommended Textbooks

1. SONNTAG, BORGNAKKE and VAN WYLEN" Fundamental of Thermodynamics".
2.YUNUS A. CENGEL and MICHAEL A. BOLES" Thermodynamics an Engineering Approach".
3. MERLE C. POTTER and CRAIG W. SOMERTON "Engineering thermodynamics".
4. T.D. ESTOP – A. MCCNKEY "Applied Thermodynamics".
5. RAYNER JOEL "Basic Engineering Thermodynamics".

ME 2308 – Engineering Mechanics II (Dynamics) (2-2-1-0)

Semester Offered

Full semester

Prerequisite

ME 1207 Calculus-II

ME 1302 Applied Physics

ME1205 Engineering Mechanics I (Static)

Course Definition

Dynamics indicates the branch of mechanics that focuses on the mechanical movement of objects and the forces that drive that movement. Thus, it is a required module for mechanical engineering students in order to promote their knowledge about the motion of bodies under the

action of forces. The study of dynamics has numerous engineering applications; the mechanical design of an automobile or bicycle, aircraft, the path of a projectile, or even the design of highways. It will also help the students interpret the movement of all moving objects which encounter them in daily lives.

Course Topics

1. Rectilinear Kinematics: Continuous Motion
2. Kinetics of a Particle: Force and Acceleration
3. Kinetics of a Particle: Work and Energy

4. Principle of Work and Energy
5. Principle of Work and Energy for a System of Particles
6. Power and Efficiency
7. Conservation of Energy
8. Principle of Linear Impulse and Momentum
9. Impact
10. Angular Momentum
11. Rotation about a Fixed Axis

Course Description

The course covers kinematics and equations of motion of a particle for rectilinear and curvilinear motion. Planar kinematics of rigid bodies. Kinetics for planar motion of rigid bodies, including equations of motion and principles of energy, impulse and momentum.

Course Objectives

Two main objectives of this course are:

1. To promote an understanding of the fundamentals and principles engineering mechanics: dynamics of particles, and rigid bodies in two and three dimensions including: kinematics and kinetics of particles and rigid bodies in 2D and 3D motion, rotations, translations, oscillations.

2. To develop the ability to apply Newtonian mechanics to model and predict the responses of simple dynamical system (particle and rigid body) subjected to applied forces.

Course Learning Outcomes

1.Understanding basics of the dynamics

2. Understand and be able to apply Newton's laws of motion

3. Understand and be able to apply other basic dynamics concepts - the Work-Energy principle,

4. Understand and be able to apply other basic dynamics concept Impulse-Momentum principle and the coefficient of restitution.

Lab Experiments

None

Textbook

R.C. Hibler, Engineering Mechanics: Dynamics, Prentice Hall, 12th ed., 2010.

ME 2309 - Mechanical Drawing (3-2-1-2)

Semester Offered
Fall semester

Prerequisites

ME 1208 Engineering Drawing

Course Definition

Mechanical drawing is the act and discipline of composing drawings that visually communicate how something functions or is constructed. It is essential for communicating ideas in industry and engineering. To make the drawings easier to understand, people use familiar symbols, perspectives, units of measurement, notation systems, visual styles, and page layout. Together, such conventions constitute a visual language and help to ensure that the drawing is unambiguous and relatively easy to understand.

Course Topics

1. Sectional views
2. Nuts, bolts, screws
3. Keys and keyways
4. Welding and welding symbols
5. Tolerancing dimensions and fits
6. Gears
7. assembly drawing

Course Description

This course provides engineering science and pre-engineering students with professional sketch skills that they need to visualize their designs, mark object dimensions, mechanical symbols, tolerances, understand others' drawings and to be able to draw assembly drawings

of parts and components. This course requires both pencil-and-paper and computer aided drawing skills.

Course Objectives

The Objectives of this course are to enable students to:

1. Represent the various geometric shapes in drawing.
2. Represent of the connection of bolts and screws to the drawing and interpretation.
3. Engage the engineering parts by symbols welding on the drawing and interpreting these symbols.
4. Determine the mechanisms of movement between the geometric parts and placing the appropriate symbols on them.
5. Draw the assembled mechanical parts and determine the mechanism or method of assembly.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Ability to describe mechanical parts by drawing.
2. Ability to determine the method of linking the mechanical parts and the status of the appropriate symbols and how to calculate the details of these symbols mathematically.
3. The ability to identify the moving mechanical parts in the machines and put the appropriate symbols for them and solve them mathematically.
4. The ability to represent mechanical parts individually, collectively and assembled.

Lab Experiments:

SOLIDWORKS lab.

Topics of engineering drawing Lab.

1. Learning of principle of SOLIDWORKS drawing.
2. Learning of 3D drawing by SOLIDWORKS.
3. Learning assembly drawing by SOLIDWORKS.

Recommended Textbooks

1. Colin H Simmons, Manual of Engineering Drawing Second edition.

2. Dr. K.L. Narayana, Dr. P. Kannaiah and K. Venkata Reddy, Machine drawing Third edition.

ME 2310 - Computer Programming (3-2-0-2)

Semester Offered

Full semester

Prerequisites:

ME 1204 Computer Science

ME 1207 Calculus-II

Course Definition

This is a required course for Mechanical Engineering Program. The course will cover the basic principles of computer Programming with FORTRAN.

Course Topics

1. Programming structures, variables/data types, read /write/print statements,
2. IF Statements.
3. Do Loops.
4. File Input and output and formatting
5. Med Course Exam
6. Arrays and Matrices
7. Subroutines and Functions
8. Programs for Engineering Applications

Course Description

This course gives an introduction to programming in this language. Language elements, data types and declaration, Arithmetic expressions, Precision. Comments, Intrinsic (built-in) procedures (functions),Simple input and output. Derived data types, Arrays (including dynamically-allocated),Logical and comparison expressions. Control statements (conditionals, loops etc.). Program units (functions, subroutines, modules). Complicated input and output, interactive and to files. Formatting and File Handling .Mathematical libraries.

Course Objectives

The Objectives of this course are to enable students to:

1. To solve problems through writing FORTRAN programs.

2. To be able to develop FORTRAN programs from specifications and document those program.
3. To understand the useful of control structures, data types, input and output process.
4. To know how to verify that the programs are running correctly.
5. To write FORTRAN programs for engineering applications.

Course Learning Outcomes

1. Write simple program modules to implement single numerical methods and algorithms.
2. Calculate solutions to mechanical engineering problems using standard numerical methods.
3. Test program output for accuracy using hand calculations and debugging techniques.
4. Analyze the applicability and accuracy of numerical solutions to diverse mechanical engineering problems.
5. Synthesize multiple program modules into larger program packages.
6. Detail numerical results into a readable format that answers specific mechanical engineering analysis and design questions.

Lab Experiments:

1. Programming structures, variables/data types, read /write/print statements,
2. IF Statements Program
3. Do Loops Program
4. File Input and output and formatting
5. Arrays and Matrices Program
6. Subroutines and Functions
7. Programs for Engineering Applications

Recommended Books

1. University of Duhram ITS,"An Introduction to Programming in FORTRAN90",2007
2. J. Adams, "Fortran 90 Handbook", Mc-Graw Hill Book Company 1992.
3. Ian D. Chivers," Introduction to Programming with Fortran", Springer ,2006.

ME 2311–Electrical Machines (3-2-0-2)

Semester Offered (Fall– Spring)

Fall semester

Prerequisites

ME 1206 Fundamentals of Electrical Engineering

Course Definition

This is a required course for the Mechanical Engineering Program. The course will cover the basic principles of electrical machines including generators, motors and transformers.

Course topics

1. DC machines construction.
2. Principle of operation of DC generators
3. Types of DC generators
4. Losses and efficiency of DC generators
5. Parallel operation of DC generators
6. Principle of DC motors
7. Types of DC motors
8. DC motors losses, efficiency
9. Speed control of DC motors
10. Transformer construction
11. principle of operation of transformer
12. Types of transformers ordinary, all-day, and auto
13. Losses and efficiencies
14. The basic principles of electrical power transmission.

Course Description

This course introduces the basic fundamentals of DC machines (Motors, Generators) and transformer. The students will be able to define, identify and categorize the devices that make up rotating machinery. The students will also learn the different characteristics of rotating machinery and transformers along with electric power transmission.

Course Objectives

1. Study the DC machines construction (Generator and Motor) and principle of operation.
2. Understand the various energy losses and efficiencies (mechanical and electrical) of DC Generators.
3. Understand the various energy losses and efficiencies (mechanical and electrical) as well as the speed control of a DC motor.
4. Explain the basic construction and operation of different types of transformers with the various energy loss and efficiencies as well as the basic electrical power transmission.

Course Learning Outcomes

1. Identify the constructions and principles of operation of DC machines (Generator and Motor).
2. Apply the basic principles to determine the various energy losses and efficiencies (mechanical and electrical) of DC Generators.
3. Apply the basic principles to determine the various energy losses and efficiencies (mechanical and electrical) as well as the speed control of a DC motor.
4. Identify the basic construction and operation of different types of transformers with the applying of basic principles to estimate the various energy loss and efficiencies as well as the electrical power transmission.

Lab Experiments:

1. The construction of DC machines.
2. Building-up voltage of self-exited shunt generator.
3. Speed control of a DC shunt motor.
4. Operation of single phase transformer.

Recommended Textbooks

1. Electrical Technology by Theraja.
2. Electric Machinery Fundamentals by S. Chapman.

Third Year (Junior Level)

ME 3301 - Engineering Analysis (2-2-2-0)

Semester Offered

Fall semester

Prerequisites

ME 2202 Calculus-IV

Course Definition

This is a required course for Mechanical Engineering Program. The course will provide a comprehensive principles of engineering analysis, thorough an up-to-date treatment of engineering mathematics. It intends to introduce students of engineering to those areas of applied mathematics that are most relevant for solving practical problems.

Course Topics

1. Modelling with Higher Order Linear Differential Equations.
2. Applications of Ordinary Differential Equations.
3. Fourier series
4. Partial Differential Equations.
5. Functions of complex variables
6. Solve various practical applications by using partial differential equations

Course Description

Homogeneous linear equations with constant coefficients; General solutions of linear equations—theory; Initial value problems vs. boundary value problems; Mechanical vibrations, fluid flow problems, heat transfer problem; Nonhomogeneous equations—undetermined coefficients; Forced oscillations and resonance; Nonhomogeneous equations—variation of parameters; Nonhomogeneous equations—variable coefficients; Fourier Series; Fourier Cosine and Sine Series; Partial Differential Equations. A Model for Heat Flow; Method of Separation of Variables; The Heat Equation; The Wave Equation; Laplace's Equation. Functions of complex variables. Polar form of a Complex Number. Trigonometric

and Hyperbolic Functions- Euler's Formula; Cauchy–Riemann Equations- Laplace's Equation.

Course Objectives

1. To enhance the student's ability to think logically and mathematically in modeling systems.
2. To use ordinary differential equation for solving practical problems.
3. To knowledge the partial differential equations (PDEs) and how they can serve as models for physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer, and advection, and electrostatics.
4. To use Fourier transforms and the convolution theorem to analyze and solve the heat equation.
5. Select and execute appropriate methods to achieve objectives.
6. Interpret and communicate the results.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Think logically and mathematically for solving practical problems such as mechanical vibrations, fluid flow problems, heat transfer problems.
2. Practice modelling and be able to translate engineering and physical situations into a mathematical model
3. To gain experience and further mastery of complete problem, solving fluency based on Fourier Series and Partial Differential Equations.
4. Use proper assumptions to describe the complex behaviour of practical problems and able to read and interpret problem objectives.

Lab Experiments

None

Recommended Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, 2011, John Wiley.
2. Mathematical Methods, by S. M. Yousuf

ME 3302 - Heat Transfer-I (3-2-1-2)

Semester Offered

Fall semester

Prerequisites

1. ME 2305 Fluid Mechanics-II
2. ME 2307 Thermodynamics -II
3. ME 2202 Calculus -IV

Course Definition

Heat Transfer is a required module for mechanical engineering students. The course presents the basic principles of two modes of heat transfer namely: conduction and radiation.

Course Topics

1. Basic of heat transfer
2. Mechanism of heat transfer
3. Forms of heat transfer
4. Multi- and one dimensional conduction heat transfer
5. Boundary and initial conditions, thermal resistance
6. Heat sources systems (heat generation)
7. Heat transfer from fins
8. Kinds of fins, fin efficiency and fin effectiveness
9. Steady-state conduction multi-dimensions (nodal solution)
10. Numerical method for analysis steady-state heat transfer
11. Unsteady-state conduction (transient)
12. Lumped heat capacity system
13. Transient numerical method
14. Transient heat conduction in plane walls, cylinders, and spheres
15. Transient heat conduction in plane walls, cylinders, and spheres Thermal Radiation and the View Factor.
16. Radiation Heat Transfer: Diffuse, Gray Surfaces, Radiosity.
17. Radiation Shields and the Radiation Effect.

Course Description

This course is an introduction to the principal concepts of heat transfer methods. Heat transfer occurs when the temperatures of objects are not equal to each other and refers to how this difference is changed to an equilibrium state. This course focuses on two different mechanisms of heat transfer: conduction (through direct contact), and radiation (through electromagnetic waves).

Course Objectives

The goals of this course are to enable students to:

1. Basic heat transfer mechanisms (conduction and radiation).
2. Heat transfer by conduction in solids for steady-state and transient conditions.
3. Heat transfer by thermal radiation.

Course Learning Outcomes

Upon the successful completion of this course, students will be able to:

1. To understand the conduction and radiation heat Transfer Mechanisms.
2. To recognize Heat Transfer from Finned Surfaces.
3. To derive the formula of steady-state conduction heat transfer in solids using numerical methods.
4. To Solve unsteady-state conduction heat transfer in small and large bodies and also by using numerical methods.
5. To Illustrate Radiation heat transfer from different colored bodies.
6. To Describe Radiation Heat Transfer, View Factor, Diffuse, Gray Surfaces, Radiosity, and Radiation Shields.

Lab Experiments:

1. Axial conduction heat transfer
2. Radial conduction heat transfer
3. Radiation heat transfer
4. Steady-state Conduction heat transfer through fins
5. unsteady-state Conduction heat transfer through fins.
6. Heat Transfer by Radiation.

Recommended Textbooks

1. J. P. Holman, "Heat Transfer", 9th Edition, 2013.
2. Yunus A. Cengel, "Heat Transfer, A Practical Approach", 2nd Edition, 2012.
3. F. P. Incropera & D. P. Dewitt, "Fundamentals of Heat and Mass Transfer", 2011.

ME 3303-Theory of Machines-I (3-2-1-2)

Semester Offered

Fall semester

Prerequisites

ME 2308 Engineering Mechanics II (Dynamics)

ME 2306 Strength of Materials-II

Course Definition

This is a required course for the Mechanical Engineering Program. It involves all three types of a course; lecture, tutorial, and laboratory.

Course Description:

This course introduces students to the principles and development of machinery. Using a systematic approach, the course will grant students' knowledge of the basic rules of machines and also ground the student in the regions of specialization within the discipline. Students will learn the various types of mechanisms and machines. The course will explore the applications of such phenomena like friction, energy transformation, .etc. in the field of machinery.

Course Topics

1. Velocity and acceleration diagrams.
2. Mechanisms with lower pairs (Hook's joint, Steering gear).
3. Gyroscopic couple.
4. Turning moment diagrams and flywheel.
5. Governors

Course Objectives

1. To give basic knowledge on kinematics and kinetics of machine elements.
2. Understand the principles of power transmission.
3. To teach students both graphical and analytical methods of motion analysis and design of planar mechanisms.
4. Gain the basic knowledge to analyse displacement, velocity and acceleration in mechanisms.
5. Understand theory of Hooke's joint, gyroscope, governors, and flywheel.

Course Learning Outcomes

Upon the successful completion of this course, students will be able to:

1. To gain basic knowledge of kinematics and kinetics for planar mechanisms.
2. Formulate and solve for distance, velocity and acceleration analysis of planar linkages.
3. Successfully practice the concepts of power transmission and steering gear mechanisms.
4. Understand the importance of gyroscopic couple, flywheel, and governors in real time practice.

Lab Experiments

1. Slider crank mechanism
2. Hooke's joint
3. Gyroscopic couple
4. Flywheel apparatus
5. Governors

Recommended Textbooks

1. Mechanics of Machines: Elementary theory and examples. By: J. Hannah and R.C. Stephens.
2. Mechanics of Machines: Advanced theory and examples. By: J. Hannah and R.C. Stephens.
3. Kinematics and Dynamics of Machines. By: G.H. Martin.

ME 3304 - Internal Combustion Engines-(2-2-2-0)

Semester Offered

Fall semester

Prerequisites

ME 2305 Fluid Mechanics-II

ME 2307 Thermodynamics-II

Course Definition

This course presents the concepts and theories of operation of internal combustion engines based upon the fundamental engineering sciences of thermodynamics, gas dynamics, heat transfer and mechanics. Discusses the design and operating characteristics of conventional spark-ignition (gasoline), compression-ignition (diesel), Wankel (rotary) and stratified charged spark-ignition engines. Thermodynamic ideal cycles are analyzed and compared to actual cycles. Fuel and air induction and exhaust processes as well as engine fuel metering and manifold phenomena are examined.

Course Topics

1. Engine Types and Their Operation, Engine Design and Operating Parameters.
2. Air standard Cycles.
3. Fuel-Air Cycles, and Actual Cycles.
4. Thermochemistry of Fuel-Air Mixtures.
5. Fuel Types.

Course Description

This course will explain the components of engines and how engines work and learn through this course how to classify engines. In addition, the types of cycles in which the engine operates and the calculation efficiency. This course will also explain how combustion and chemical reactions of combustion occur. The student will also learn fuel types and specifications.

Course Objectives

1. Teaching students how to classify engines and their components and calculate efficiency.
2. Study of standard air cycles and how to calculate workout and mean effective pressure and efficiency for each standard cycle.
3. Solve fuel-air and actual cycles and how to calculate their efficiency and apply them to the engines when the temperature is the specific heat as a function of temperature.
4. Study the chemical reactions and calculate the amount of heat produced by the combustion process. As well as calculating the air to fuel ratio (A/F).
5. Study fuels and know the properties of each fuel and the relationship between fuels.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Understand the fundamentals, operation , and performance of internal combustion engines and their different types. Also to calculate the various performance parameters of the engines.
2. Identify Otto, Disel, and Combined Cycles. Analysis of Intake and Exhaust.
3. Apply measurement of fuel and air consumption, volumetric efficiency, effect of air-fuel ratio and compression ratio on engine power & efficiency, pumping work.
4. Discover Fuels and Combustion, Gasoline characteristics, alcohol refining and octane & cetane rating, diesel fuel oil classification, combustion equation, knock and the engine variable detonation, combustion theories, chemical equilibrium and dissociation, energy charts for unburned air mixtures, combustion chamber requirement.

Lab Experiments:

Currently, there is no ICE lab.

Recommended Textbooks

1. Internal Combustion Engine Fundamentals by J.B. Heywood
2. Internal Combustion Engines by C.R. Ferguson
3. Introduction to I. C. Engines by Richard Stone

ME 3305 - Manufacturing Processes (2-2-1-0)

Semester Offered

Full semester

Prerequisites

ME 1301 - Principles of Manufacturing Process

ME 2304 - Engineering Metallurgy

Course Definition

Studying the basic principles of industrial safety and metal extraction and manufacturing processing.

Course Topics

1. Tensile properties
2. Compression properties
3. Shear properties
4. Hardness
5. Effect of Temperature on Properties
6. Fluid Properties
7. Bulk deformation
8. Rolling
9. Forging
10. Extrusion
11. Wire and bar drawing

Course Description

The course of manufacturing processes addresses industrial safety, measuring instruments, the production or extraction of metallic materials (ferrous and nonferrous), manufacturing operations, basic - plumbing, sand, die and centrifugal casting. Also, it involves deformation process (rolling, forging, extrusion, wire and rod drawing and sheet metal deformation). In addition, it includes of metal machining (turning, drilling, and milling). welding process (arc welding, gas welling and spot welling).

Course Objectives:

1. Students should understand of the principles of the major manufacturing processes.
2. Students should be able to recognize the standard processes used to produce products
3. Students should be able to select the optimal process to produce a product

Course Learning Outcomes:

1. To gain information about different bulk deformation processes (forging, rolling, extrusion, drawing).
2. To gain knowledge about the nonconventional machining processes.
3. An ability to understand the theory of metal machining.

Recommended Textbook(s)

1. Fundamentals of Modern Manufacturing" Fourth Edition by Mikell P. Groover
2. Manufacturing Engineering and Technology by Kalpakjian
3. Materials and Processes in Manufacturing by E.P Degarmo

Lab Topics

Currently, there is no manufacturing processes lab.

ME 3306 - Research Methodology (1-1-0-0)

Semester Offered

Fall semester

Prerequisites

None.

Course Definition

It is the general research strategy that outlines the way in which research is to be undertaken and, among other things, identifies the methods to be used in it. It does not define specific

methods, even though much attention is given to the kinds of processes to be followed in a particular procedure or to attain an objective.

Course Topics

1. Project proposal.
2. Basic of research methodology
3. Review of previous works.
4. Nature of the projects
5. Results analysis
6. How to write your project.
7. PPT Slides preparation and viva presentation

Course Description

The course covers principles of project proposal, basic of project methodology, overview of the previous works, nature of projects, dealing with results, academic writing, and PPT slide preparation and viva presentation.

Course Objectives

1. To enable the students to know the qualitative of the project.
2. To know the information needs for project and research management.
3. To introduce the concept of scientific research, methodology, methods, and processes.
4. To connect multidisciplinary sciences in one project, and
5. To introduce the statistical tools of data analysis.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Know the qualitative of the project.
2. Know the necessary information needed for project and research managements.
3. Understand the concept of scientific research, methodology, methods, and process.
4. Know how to merge different sciences field in one project.
5. Use the statistical tools for data analysis.

Recommended Textbooks

- Krishnan Nallaperumal, ENGINEERING RESEARCH METHODOLOGY, a computer science and Engineering and Information and Communication Technology perspective, First Edition, 2014, New Delhi, India.
- Kothari CR, Research methodology-methods and techniques, New Wiley Eastern ltd., Delhi, 2009.

ME 3307 - Heat Transfer-II (3-2-1-2)

Semester Offered

Spring semester

Prerequisites:

ME 3302 Heat Transfer-I

Course Definition

Heat Transfer is a required module for mechanical engineering students. The course presents the basic principles of convection heat transfer.

Course Topics

1. Physical Mechanism of Convection
2. Classification of Fluid Flows
3. Thermal Boundary Layer
4. Hydraulic boundary layer
5. External Forced Convection
6. Parallel Flow over Flat Plates
7. Flow across Cylinders and Spheres
8. Flow across Tube Banks
9. Internal Forced Convection
10. Laminar Flow in Tubes
11. The Entrance Region
12. Turbulent Flow in Tubes
13. Natural Convection from Finned Surfaces

14. Natural Convection inside Enclosures
15. Combined Natural and Forced Convection

Course Description:

Heat Transfer II is a required module for mechanical engineering students. Convection heat transfer is studied in both internal and external geometries under laminar and turbulent flow regimes. Free convection is also considered where heat transfer is due to flow induced by fluid buoyancy. Heat Exchangers Types and the effective NTU relations are studied as well as Boiling and Condensation empirical correlations.

Course Objectives:

The goals of this course are to enable students to:

1. Basic heat transfer mechanisms (Convection).
2. Laminar and turbulent flow regimes through internal and external geometries.
3. Heat Exchangers.
4. Boiling and Condensation heat transfer.

Course Learning Outcomes:

Upon the successful completion of this course, students will be able to:

1. To understand the free and forced convection heat Transfer Mechanisms.
2. To recognize the internal and external convection heat transfer.
3. To distinguish the laminar and turbulent convection heat transfer of internal and external flows.
4. To Illustrate convection heat transfer from fins.
5. To Solve the combined free and forced (Mixed) convection heat transfer.

Lab Experiments:

1. Free Convection Heat Transfer.
2. Forced Convection Heat Transfer.
3. Double-pipe Heat Exchangers: (Effect of flow direction).
4. Double-pipe Heat Exchangers: (Effect of flowrate).
5. Double-pipe Heat Exchangers: (Effect of inlet hot water temperature).

Recommended Books:

1. J. P. Holman, "Heat Transfer", 9th Edition, 2013.

2. Yunus A. Cengel, "Heat Transfer, A Practical Approach", 2nd Edition, 2012.
3. P. Incropera& D. P. Dewitt, "Fundamentals of Heat and Mass Transfer", 2011.

ME 3308 - Theory of Machines-II (3-2-1-2)

Semester Offered

Full semester

Prerequisites:

ME 3303 Theory of Machines-I

Course Definition

This is a required course for the Mechanical Engineering Program. It involves all three types of a course; lecture, tutorial, and laboratory.

Course Topics

1. Balancing of rotating masses
2. Spur Gearing
3. Gear trains
4. Belt drive
5. Cams

Course Description

This course introduces students to the principles and development of machinery. Using a systematic approach, the course will grant students' knowledge of the basic rules of machines and also ground the student in the regions of specialization within the discipline. Students will learn the various types of mechanisms and machines. The course will explore the applications of such phenomena like friction, energy transformation, etc. in the field of machinery.

Course Objectives

1. To give basic knowledge on kinematics and kinetics of machine elements.
2. Understand the principles of power transmission.
3. To teach students both graphical and analytical methods of motion analysis and design of planar mechanisms.
4. Understand of techniques for studying angular and linear motion of rotating machines.
5. By the end of this course student will be able to achieve complete analysis of mechanism including (cams, gears, gear trains, and belt drive).

Course Learning Outcomes

Upon the successful completion of this course, students will be able to:

1. To gain basic knowledge of kinematics and kinetics for planar mechanisms.
2. Apply the kinematic analysis in subsequent courses in the design and analysis of various machine components.
3. Identify gear and gear train parameters and perform analysis and kinematical design of gear trains.
4. To learn the analysis and design of cam system and perform static and dynamic balancing of rotating machinery.

Topics of Theory of Machines II Lab

1. Statistical procedure to find the best fit for a set of experimental data.
2. Static balancing of rotating masses.
3. Dynamic balancing of rotating masses.
4. Determination of moment of inertia of a flywheel.
5. Cams.

Recommended Textbook(s)

1. Mechanics of Machines: Elementary theory and examples. By: J. Hannah and R.C. Stephens.
2. Mechanics of Machines: Advanced theory and examples. By: J. Hannah and R.C. Stephens.
3. Kinematics and Dynamics of Machines. By: G.H. Martin.

ME 3309 - Gas Dynamics (2-2-2-0)

Semester Offered

Full semester

Prerequisites:

ME 2305 Fluid Mechanics-II

ME 2307 Thermodynamics-II

Course Definition

This is a required course for Mechanical Engineering Program. The course will cover the basic principles of Gas Dynamics.

Course Topics

1. Compressible fluid flow
2. One Dimensional Isentropic flow
3. Normal shock Waves
4. Oblique shock Waves
5. Flow in constant area duct with friction (Fanno flow)
6. Flow in constant area duct with heat transfer (Rayleigh flow)

Course Description:

Explores fundamentals of gas dynamics and compressible fluid flow including one-dimensional isentropic flow; one-dimensional flow with friction and with heating or cooling; normal shock relations; oblique shocks and expansion waves; the moving normal shock wave; flow in variable area ducts; nozzles and diffusers; shock tubes; Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties ;Simple heating relation of a perfect gas, Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.

Course Objectives:

The Objectives of this course are to enable students to:

1. Understand the compressible flow fundamentals.

2. Solve isentropic flow in variable area ducts.
3. understand various shock wave situations and the use of gas tables.
4. Study the compressible flow with friction.
5. Study the compressible flow with heat transfer.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Ability to solve the properties of compressible fluid flow, one Dimensional isentropic flow.
2. Ability to solve and analysis of Normal and Oblique shock waves.
3. The ability to determine the properties of the flow in constant area duct with friction (Fanno flow) and its applications.
4. The ability to determine the properties of the flow in constant area duct with heat transfer (Rayleigh flow) and its applications.

Recommended Books:

1. James E.A. John , Theo G. Keith ," Gas Dynamics, 3rd Edition,John-Wiely,2006
2. The Dynamics and Thermodynamics of Compressible Fluid Flow (Vol.1), by A.H. Shapiro, Ronald, 1953.
3. Power Plant Technology, by M.M. El-Wakil.
4. Steam Turbines Theory and Practice, by W.J. Keartin.

ME 3310 - Industrial Engineering and Economic Analysis (2-2-1-0)

Semester Offered

Full semester

Prerequisites

1. ME 3305 Manufacturing Processes
2. ME 3201 – Engineering Statistics

Course Definition

This is a required course for Mechanical Engineering Program. The course will cover the basic principles of Industrial Engineering and Economic Analysis.

Course Topics

1. Process of organization design
2. Product layout flow
3. Systematic layout planning
4. Flow process charts
5. Bill of material
6. Material handling
7. Human engineering
8. Quality control and Inspection
9. Control chart for attributes
10. Industrial safety.

Course Description

This is a required course for the Mechanical Engineering Program. Production and services systems inputs and output, management concepts and history, Management systems role & functions of management. Factors affecting industrial development, industrial development of Iraq, organization structures & types. Productivity, basic concepts, classification, measurement and improvement. Role of work study, work measurement and work sampling. Plant location criteria, equipment and utilities layout, types of layout. Material handling systems. Types of production, group technology, variety control, make or buy decisions. Demand forecasting, useful forecasting models, material requirement planning, capacity requirement planning MRPII. Inventory models and Just in time (JIT) technique, production planning, scheduling problems & models, Industrial safety.

Course Objectives

1. Understand the theoretical workings of the organization structures & types, Productivity, basic concepts, classification, measurement and improvement.
2. Understand the relationship between a facility layout location criterion, equipment and utilities layout, types of layout and Material handling systems.
3. To determine the direct cost, underact cost, and Productivity.

4. Solve demand forecasting, , material requirement planning MRP, Bill of material (BOM)
5. Understand the applications of, Inventory models and Just in time (JIT) technique, production planning, scheduling problems & models.
6. Learn Industrial safety and application.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. An ability to understand the theoretical workings of the organization structures & types, Productivity, basic concepts, classification, measurement and improvement.
2. An ability to planning of plant using the relationship between a Plant location criterion, equipment and utilities layout, types of layout and Material handling systems. Bill of material (BOM)
3. To gain experience and further mastery of complete problem solving fluency based on determine the fixed cost, variable cost, Productivity, forecasting, material requirement planning MRP.
4. An ability to applications of, Inventory models, Just in time (JIT) technique, ISO, production planning, scheduling problems & models.
5. Learn proper Industrial safety and application.

Lab Experiments:

None

Recommended Textbooks

1. Production & Operations Management by Evert E. Adam Jr and Ronald.
2. Production Management by Kieth & Loekyer.
3. Analysis & Control of Production Systems by Elsayed & Boucher.
4. Engineering Economy by D. Garmo.

Fourth Year (Senior Level)

ME 4301- Design of Machine Elements-I (3-3-1-0)

Semester Offered

Full semester

Prerequisites:

ME 3308 Theory of Machines-II

Course Definition

Machine Design or Mechanical Design can be defined as the process by which resources or energy is converted into useful mechanical forms, or mechanisms so as to obtain useful output from the machines in the desired form as per the needs of the human beings. Machine design can lead to the formation of an entirely new machine or can lead to up-gradation or improvement of the existing machine.

Course Topics

1. Fundamentals of mechanical engineering design
2. Failures Resulting from Static Loading
3. Fatigue Failure Resulting from Variable Loading
4. Shafts and Shaft Components
5. Screws, Fasteners, and the Design of Nonpermanent Joints
6. Welding, Bonding, and the Design of Permanent Joints

Course Description

This course covers basic criteria of the performance and design of machine parts, determination of permissible and actual stresses. The first part of the course deals with the analysis and design of parts subjected to static loading, variable loading, and how to proportion them to successfully resist such conditions. The second part provides a classical treatment on the design of machine elements such as shafts, screws, fasteners, welding, and bonding by presenting established design methodologies as set by the appropriate organizations.

Course Objectives

1. To cover the basics of machine design, including the design process, engineering mechanics and materials, failure prevention under static and variable loading, and characteristics of the principal types of mechanical elements
2. To offer a practical approach to the subject through a wide range of real-world applications and examples
3. To encourage students to link design and analysis
4. To encourage students to link fundamental concepts with practical component specification.
5. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Apply stress analysis theory and appropriate criteria of failure to the design of simple machine elements
2. Design shafts for static and variable stresses and estimate stress concentration.
3. Design of Screws, Fasteners, and the Design of Nonpermanent Joints.
4. Design of welding, bonding and other permanent joints.

Lab Experiments

None

Recommended Book(s)

1. Mechanical Engineering Design by *Shigley*, 9th Edition, 2011.
2. Mechanical Engineering Design by *Shigley*, 10th Edition, 2015.
3. Mechanical Engineering Design by *Shigley*, 11th Edition, 2020.
4. Machine Design By *Khurmi*, Fourteenth Edition, 2005.

ME 4302 - Air Conditioning (3-2-1-2)

Semester Offered

Full semester

Prerequisites

ME 3307 Heat Transfer-II

Course Definition

Air conditioning is part of the curriculum of Mechanical Engineering Program. This course covers the key aspects of air conditioning, including the calculation of the moist air properties, the use of the psychometric chart, the estimation of the heating and cooling loads, as well as the design of air ducts and air conditioning systems.

Course Topics

1. Introduction to air conditioning
2. Moist air properties
3. Psychrometric chart and psychrometry processes
4. Thermal comfort
5. Indoor and outdoor design conditions
6. Heating load calculation
7. Cooling load calculation
8. Air conditioning systems
9. Air distribution systems and duct design

Course Description

History of air conditioning, units and dimensions, review of basic principles, vapour pressure, moisture content, relative humidity, dry and wet bulb temperatures, specific volume, dew point, enthalpy, psychrometric chart, mixtures, sensible heating and cooling, dehumidification, humidification, cooling & dehumidification with reheat, heat balance equation, comfort charts, prediction of thermal comfort, indoor & outdoor design conditions, overall heat transfer coefficient, heat loss in building, ventilation heat loss, infiltration heat loss, air required for heating space, heat gain from external & internal sources, space cooling load, cooling coil load, cooling load calculation, functions of air conditioning systems,

unitary systems, central-station systems, system selection & applications, economic evaluation, basic principles of air flow in ducts, duct sizing, duct design methods, supply air outlets and air distribution patterns.

Course Objectives

1. Explain the properties of moist air and how to calculate each property.
2. Use the psychrometric chart to find the properties of the moist air, as well as the representation of air conditioning processes.
3. Encourage students to link with the procedure of simplified estimations of the heating and cooling loads.
4. Cover the types of air conditioning systems.
5. Illustrate to students of the methods used to calculate the sizes of air ducts, as well as the overall pressure drop in air ducts system.

Course Learning Outcomes

1. Apply the basic concepts of thermodynamics and the psychrometric chart to evaluate the moist air properties and analysis the air conditioning processes.
2. Evaluate the heating and cooling loads of a building, as well as identify the appropriate indoor and outdoor design conditions of certain applications.
3. Compare the various types of air conditioning systems
4. Design the air ducts and identify the total pressure drop for the ducting system.

Lab Experiments:

1. Illustrative air conditioning unit.
2. Cooling & dehumidification process.
3. Heating & humidification process.
4. Central air conditioning system.
5. Cooling tower performance.
6. Car air conditioning system
7. Scientific visit to some air conditioning systems used in the University buildings.

Recommended Textbooks

1. Refrigeration and Air Conditioning by Ahmadul Ameen.

2. Refrigeration and Air Conditioning by S.N. Sapali.
3. Refrigeration and Air Conditioning by C.P. Arora.
4. Refrigeration and Air Conditioning by Er. R.K. Rajput.

ME 4303 - Power Plant (2-2-1-0)

Semester Offered (Fall– Spring)

Fall semester

Prerequisites

ME 3307 Heat Transfer II

ME 3309 Gas Dynamics

Course Definition

This is a required course for Mechanical Engineering Program. The course will cover the basic principles of Power Engineering Technology. This course provides the student with an introduction to the major systems and components that make up a modern power plant.

Course Topics

5. Introduction of thermodynamic cycles used in power plants
6. Advanced Rankine Cycle (Reheating, Regenerative)
7. steam generators, steam condensers
8. Steam turbines
9. Introduction to gas turbine power plants
10. modification of the basic cycle (intercooling & reheating)
11. modification of the basic cycle (Regeneration)
12. Introduction to Diesel Power Plant
13. Cooling, lubricating, supercharging of Diesel Power Plant
14. Diesel engine performance and operation
15. Economics of Power Plants
16. Cost analysis of a power plant
17. Nuclear power plants
18. Components and site selection of nuclear power plants

Course Description

Introduction of thermodynamic cycles used in power plants, Carnot cycle, Rankine Cycle, Rankine Cycle with Superheating, reheat Rankine Cycle, efficiencies in Steam Power Plant, regenerative Rankine Cycle, forward and backward flow heaters, general layout of modern steam plants, steam generators, engines and auxiliary components, back pressure and pass out turbines. Deviation of actual cycle from ideal cycle, losses in pipes, turbine, pump and condenser, the selection of site for steam power plant, steam nozzle, steam turbines, energy losses in steam turbine, velocity diagram for moving blade impulse turbine. Development and improvement of gas turbine, the practical gas turbine cycle, modification of the basic cycle. Isentropic efficiency of compressors and turbines, intercooling, reheating, and regeneration.
The advantages and disadvantages of diesel Power Plants, application of Diesel Power Plant; Site Selection, classification of Diesel Engines, diesel plant operation, supercharging system of diesel power plant, essential components of diesel Engine, cooling system of diesel Power Plant, lubrication System. Introduction to nuclear reactions as energy sources, components of nuclear plants. Site Selection, classification of turbines, Terms and Definitions (Economics Factors), the principles of power plant design, cost of electric energy, fixed and operating Costs, cost analysis, how to Minimize Power Generation Cost, comparison of economics of various power plants.

Course Objectives

1. To provide an overview on power generation through various methods.
2. To learn the layout of different conventional power plants.
3. To understand the various components, operations and applications of different types power
plant.
4. To study the principles of nuclear reaction and different nuclear reactor
5. To understand the working of diesel and gas turbine power plant
6. To create awareness about cost of electric energy, cost calculation and economics of various
power plants.

Course Learning Outcomes

1. Apply the basic concepts of thermodynamics to evaluate the efficiency of modern Rankine cycle steam power plants with implementation of superheating, reheating, regeneration.
2. Identifying the performance of gas turbines with modern enhancing efficiency methods including intercooling, reheating and regeneration.
3. Understanding the essential components and working principles of diesel power plants along with performing heat balance of the plant.
4. Ability to identify the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized-water, boiling-water, and heavy-water reactors.
5. Identifying the cost analysis of various power plants.

Lab Experiments:

Determination of the relationship between pressure and temperature of saturated vapor

Recommended Textbooks

1. Power Plant Technology by M. M. El Wakil
2. Power plant by F.T. Morse
3. Power Plant Engineering by R. K. Hegde
4. Applied Thermodynamics for Engineering Technologist by T. D.Eastop & J Mc. Conkey

ME 4304 - Mechanical Vibrations (3-2-1-2)

Semester Offered

Fall semester

Prerequisites

ME 2308 – Engineering Mechanics II (Dynamics)

ME 2306 - Strength of Material- II

ME 3301 - Engineering Analysis

Course Definition

Mechanical vibration can be modelled as the measurement of a periodic synthesis of oscillations with respect to a balance point. This model should provide significant concepts including vibrational analysis, uncertainty modelling, and vibration control systems. It should also present a good fundamental ground in computational data, mathematical modelling and evaluation in performance of multiple mechanical vibration systems. Attention will be paid to vibrating systems such as shafts, beams, strings, plates and membranes, vibration isolation, critical speeds, the balancing of rotating and reciprocating machinery. Finally, each chapter of this model will involve many examples relating to problems of mechanical vibration and the methods used in their solution.

Course Topics

• Harmonic motion
• Free vibration of undamped SDOF systems (Newton's laws, Energy Method)
• Longitudinal and torsional vibrations of bars or Shafts
• Free vibration of viscously damped SDOF systems
• Free vibration of damped SDOF systems with Coulomb and hysteretic damping
• Harmonically forced SDOF systems (rotating imbalance, support motion, vibration isolation, whirling)
• Forced vibrations of Coulomb-damped and hysteresis-damped SDOF systems, self-excited vibrations
• Free vibration of 2 DOF systems
• Eigenvalue problem for free vibration of 2 DOF
• Forced vibration of 2 DOF systems
• Equations of motion for MDOF systems
• Forced vibrations of MDOF systems using modal analysis
• Forced vibrations of viscously damped MDOF systems

Course Description

The course describes the fundamental laws (e.g., Newton's laws of motion, energy method, Lagrange's method) can be applied to derive, compute and analyse the mechanical vibrations systems. These include natural frequencies, modes of vibrations, resonance phenomenon,

effect of damping factor for single and multi-degree of freedom systems. The calculation of these values provide practical solutions to avoid excessive vibrations to mechanical systems. Thus students will be able to model mathematical relations, derivation/solution of equations of motion. The course also will reinforce the skills students relating to how to utilize experimental techniques of vibration measurement.

Course Objectives

1. Formulate mathematical models of problems in vibrations using Newton's second law or energy principles.
2. familiarize the student with the underlying concepts of linear mechanical vibrations through analysis of the free and forced responses of various single degree-of-freedom (SDOF) and multiple degree-of-freedom (MDOF) systems.
3. Determine a complete solution to the modelled mechanical vibration problems.
4. Correlate results from the mathematical model to physical characteristics of the actual system

Course Learning Outcomes

At the end of this course, students will be able to:

1. Derive the equations of motion for single degree of freedom (SDOF) and multi-degree of freedom systems (MDOF).
2. Understand the goal of damping systems in mechanical vibrating systems.
3. Model, calculate and interpret the response of vibrating of single degree of freedom (SDOF) and multi-degree of freedom systems (MDOF).
4. Analyse the vibratory behaviour of different mechanical vibration systems subjected to harmonic force or impulsive force.
5. Design model systems that minimize the transmission of vibration to mechanical or structural systems.

Lab Experiments:

1. Angular vibration of rigid bodies
2. Vibration of spring-mass system.
3. Free torsional vibration

4. Torsional vibration of multi-degree of freedom (MDOF) systems

Recommended Textbook(s)

1. Mechanical Vibrations: Theory & Applications by W.T. Thompson.
2. Mechanical Vibrations by S. S. Rao.

ME 4306- Design of Machine Elements-II (3-3-1-0)

Semester Offered

Spring semester

Prerequisites:

ME 4301 Design of Machine Elements-I

Course Definition

Design of machine elements is defined as the use of imagination, scientific principles and engineering techniques to create elementary components of machine or structure economically, in order to satisfy the industry requirements and then needs of customers. The focus in this course is on blending fundamental development of concepts with practical specification of components so that students find them familiar with both the basis for decisions and the standards of industrial components.

Course Topics

1. Mechanical Springs
2. Rolling-Contact Bearings
3. Lubrication and Journal Bearings
4. Gears-General.
5. Spur, Helical, Bevel, and Worm Gears
6. Clutches, Brakes, Couplings, and Flywheels.

Course Description

Fundamentals of gears are included to address the design of compound gear trains to achieve specified gear ratios. The discussion of the relationship between torque, speed, and power is clarified. Design of rolling bearing introduces the invariant, the statistical distribution of life as well as some useful deterministic equations addressing load versus life at constant reliability. The importance of lubrication in reducing friction, wear, and heating of machine parts that move relative to each other is explained. Recent metallurgy developments in bearing materials combined with increased knowledge of the lubrication process give a possibility to design journal bearings with satisfactory lives with very good reliabilities. This course discusses the more frequently used types of springs, their necessary parametric relationships, and their design. Moreover, the course provides a classical treatment on the design of machine elements such as brakes, clutches, and flywheels, and their applications by presenting established design methodologies as set by the appropriate organizations.

Course Objectives

The goals of this course are to enable students to:

1. To introduce students to the design and theory of common machine elements and to give students experience in solving design problems involving machine elements.
2. To combine forces, moments, torques, stress and strength information to develop ability to analyze, design and/or select machine elements. With attention to safety, reliability, and societal and fiscal aspects.
3. To require the student to prepare professional quality solutions and presentations to effectively communicate the results of analysis and design.
4. To be acquainted with standards, safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Recognize the fundamentals of the theory of lubrication and journal bearings
2. Design of specific mechanical elements including: gears, gear trains, clutches, coupling, brakes, springs, ropes and chains drives.
3. Recognize the fundamentals of the Rolling-Contact Bearings.

4. Design and evaluation of a machine component that is created to satisfy a specific need. Also, gain an appreciation for and become proficient in applying the final steps of the engineering design process.

Lab Experiments

None

Recommended Book(s)

1. Mechanical Engineering Design by *Shigley*, 9th Edition, 20011.
2. Mechanical Engineering Design by *Shigley*, 10th Edition, 2015.
3. Mechanical Engineering Design by *Shigley*, 11th Edition, 2020.
4. Machine Design By *Khurmi*, Fourteenth Edition, 2005.

ME 4307-Refrigeration (3-2-1-2)

Semester Offered (Fall - Spring)

Spring semester

Prerequisites

ME 2307 Thermodynamics-II

ME 3307 Heat Transfer-II

Course Definition

Refrigeration is part of the curriculum of Mechanical Engineering. This course covers some aspect of Refrigeration Engineering, including a review of basic principles, the vapour compression cycles and heat pumps, the refrigerants, the vapour absorption cycles, the air refrigeration cycles, the thermoelectric refrigeration, the vortex tube refrigeration, as well as the steam jet water vapour refrigeration system.

Course Topics

1. Introduction and review of basic principles.
2. Vapour compression cycle and heat pumps.
3. Refrigerants.

4. Vapour absorption cycle.
5. Air refrigeration systems.
6. Thermoelectric refrigeration.
7. Vortex tube refrigeration.
8. Steam jet water vapour refrigeration system.

Course Description

History of refrigeration, applications of refrigeration, current status & future trends, units, thermodynamics, heat transfer, fluid mechanics, vapour compression cycle, refrigerator & heat pump, ideal vapour compression refrigeration cycle, practical vapour compression cycle, multi pressure vapour compression cycles, classification of refrigerants, desirable properties of refrigerants, common refrigerants, simple vapour absorption cycle, practical absorption systems, properties of refrigerants & absorbents, absorption cycle analysis, Bell-Coleman or reversed Brayton cycle, application of aircraft refrigeration, simple air cooling system, Boot-Strap air cooling system, regenerative air cooling system, thermoelectric refrigeration, vortex tube refrigeration, steam jet water vapour refrigerating system.

Course Objectives

The Objectives of this course are to enable students to:

1. Understand the parts of the vapour compression cycle, and how to analyze and solve the relevant exercises.
2. Have knowledge of the refrigerants, and the most important properties which must be available in them.
3. Familiarize the students on how the vapour absorption cycles operate, as well as the procedure to analyze and solve the relevant exercises.
4. Identify the types of air refrigeration cycles, and how to analyze and solve the relevant exercises.
5. Have knowledge of the thermoelectric, vortex tube, and steam jet water vapour refrigeration systems.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Analysis the performance of the vapour compression cycles and understand the most important properties which must be available in the refrigerants.
2. Estimate the performance parameters of the lithium bromide-water absorption refrigeration cycles for a certain cooling load.
3. Apply the laws of thermodynamics on the air refrigeration cycles.
4. Explain the components and the principle of work of the thermoelectric, vortex tube, and steam jet water vapour refrigeration systems.

Lab Experiments:

1. Illustrative refrigeration unit.
2. Mechanical heat pump.
3. Diagnosis of faults in vapour compression systems.
4. Electrolix refrigerator.
5. Thermo-electric refrigeration.

Recommended Textbooks

1. Refrigeration and Air Conditioning by AhmadulAmeen.
2. Refrigeration and Air Conditioning by S.N. Sapali.
3. Refrigeration and Air Conditioning by C.P. Arora.
4. Refrigeration and Air Conditioning by Er. R.K. Rajput.

ME 4308 - Engineering Materials (2-2-1-0)

Semester Offered

Full semester

Prerequisites

1. ME 2304 Engineering Metallurgy
2. ME 2306 Strength of Materials-II
3. ME 3305 Manufacturing Process

Course Definition

In this subject the properties of engineering materials is studied as well as the limits of their use and the classification of these materials according to their structure. Also, the selecting methods of engineering materials for each application are investigated.

Course Topics

1. Material Properties
2. Mechanical Properties
3. Temperature Effect
4. Physical Properties
5. Engineering Materials (Ferrous Metal)
6. Engineering Materials (Nonferrous Metal)
7. Engineering Materials (Non-metallic)
8. Designation the Engineering Materials
9. Selection of Materials

Course Description

Properties of materials (Mechanical tensile properties, fatigue cyclic stresses, stress life behavior, S-N curves. Factor affecting fatigue life, safe-life predication. Creep test, chemical properties (corrosion and corrosion resistance, corrosion protection), classification of materials (ferrous and nonferrous metals, properties, classification). Polymer structures, hydrocarbon molecules, thermoplastic and thermosetting. Stress-strain behavior. semi crystalline, plastic, fibers, ceramic structure and properties, silicate ceramics, glasses and glass ceramic, clay products, cements, advanced ceramics. Composites materials, fiber composite, large-particle composites, dispersions strengthened composite, matrix phase, polymer-matrix composites, martials selection Materials Selection Methodology, Ranking the materials by their ability to meet the objectives .

Course Objectives

The goals of this course are to enable students to:

1. Understand the practical concepts of engineering materials and their properties and applications.

2. Apply the knowledge of material properties and material selection foundations that are related to mechanical Engineering program.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Obtain important information of the mechanical properties of materials.
2. Classified the materials.
3. Select the optimal material for each application.
4. Analyze any type of failure and find the reasons of failure.
5. To know the developments of new materials.

Lab Experiments

None

Recommended Textbooks

J T. Black, R. A. Kohser and E. P. Degarmo, " Materials and processes in manufacturing ", 10th Edition, 2008.

Materials Science and Engineering an Introduction William D. Callister, Jr.

Foundations of Materials Science and Engineering, by William F. smith & Javad Hashemi

Ceramic Science for Materials Technologist by T.J Mc-Calm

Engineering with polymers by P.C. Powel

ME 4309 - Control Systems (2-2-2-0)

Semester Offered

Fall semester

Prerequisites:

ME 2202 Calculus -IV

ME 3301 - Engineering Analysis

Course Definition

Engineering control is the study of the analysis and regulation of the output behaviors of dynamical systems subject to input signals. It involves the design of engineering products or systems where a requirement is to accurately control some quantity. It is essential for students pursuing degrees in electrical, mechanical, aerospace, biomedical, or chemical engineering. Control systems are found in a broad range of applications within these disciplines, from aircraft and spacecraft to robots and process control systems.

Course Topics

1. Introduction to automatic control system
2. Representation of control components
3. Representation of control systems:

- ✓ Mass, spring damper system
- ✓ Hydraulic system
- ✓ Pneumatic system
- ✓ Electrical system
- ✓ Thermal system

4. Steady-state operation
5. Laplace transformer
6. Transient and steady-state responses
7. Steady-state errors in control systems
8. Stability of control systems
9. The rout locus method
10. Measurement systems

Course Objectives

1. Demonstrate an understanding of the fundamentals of (feedback) control systems.
2. Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
3. Express and solve system equations in state-variable form (state variable models).
4. Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.

5. Determine the (absolute) stability of a closed-loop control system.
6. Apply root-locus technique to analyze and design control systems.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Identify open and closed loop control system and formulate mathematical model for physical systems.
2. Interpret and apply block diagram representations of control systems and compute their stability based on Routh array test.
3. Use Evans root locus techniques in control design for real world systems and analyze the performance of system using Frequency response methods
4. Learn how to identify various measurement systems, errors of measurement, as well as explain working principles of sensors and transducers.

Lab Experiments

None

Recommended Book(s)

1. Automatic Control Engineering, First Edition 1961, by Francis H. Raven, McGraw Hill.
2. Measurement Systems Applications and Design, 5th edition 2003, by E. Doebelin, McGraw Hill.
3. Modern Control Systems, Twelfth Edition 2011, by Richard C. Dorf and Robert H. Bishop, Prentice Hall.
4. Ogata, K. (2010). Modern control engineering (Vol. 5). Upper Saddle River, NJ: Prentice hall.

Fourth Year Elective Courses

ME 4301E - Computer Applications (2-2-0-0)

Semester Offered

Fall semester

Prerequisites

4. Mechanical Drawing.
5. Strength of Materials.
6. Fluid Mechanics-II
7. Heat Transfer-II.
8. Calculus-IV

Course Definition

The drawing and assemble of mechanical parts, orthographical views and dimensions, drawing standard parts and tools, modelling and simulation of different fields of mechanical engineering.

Course Definition

This course shows and explains how to design and create mechanical engineering drawings in a 3D using a sophisticated program (SolidWorks® 2014-2020). Emphasis is placed on creating engineering drawings including dimensions and using standard parts from the program library and then test them. The course also lets the students to learn the principles of assembly design and structural analysis using SolidWorks-Simulation in several fields of mechanical engineering using finite element approach (FEA). After testing the designed part, the students will be able to optimize the design according to the criteria of more strength material, higher temperature, larger load, more stiffness, higher pressure, etc.

Course Topics

1. Interface and applications of Solidworks (a sample software)
2. 3D drawing and dimensions
3. Orthographic views and cutting

4. Threads of screws
5. Threads of nuts
6. Gears drawing
7. Boundary conditions, meshing and simulation
8. Simulations (thermal systems applications)
9. Simulations (materials applications)
10. Simulations (design applications)
11. Simulations (Fluid mechanics applications)
12. Simulation for providing the optimal design

Course Objectives

The goals of this course are to enable students to:

1. To develop the students' skills for designing mechanical parts.
2. To know how to assemble several parts into one group.
3. To learn how to view different views for the drawn part.
4. To be able how to draw the gears, pulleys, and belts.
5. To be able how to simulate and model several fields in the mechanical engineering.

Course Learning Outcomes

Upon the successful completion of this course, students will be able to:

1. Design and drawing mechanical parts.
2. Know how to apply the initial and boundary condition with meshing the geometry.
3. Learn how to simulate several mechanical engineering applications.
4. Aware how to optimize the design of any mechanical part.

Lab Experiments:

Computer lab.

Recommended Textbooks

1. James D. Bethune, Engineering Design and Graphics with SolidWorks® 2016, first edition, Boston: Pearson, 2017.
2. Matt Weber, Gaurav Verma, SolidWorks simulation 2015 Black book, CADCAMCAEWORKS, USA, 2015.

ME 4302E - Renewable Energy (2-2-0-0)

Semester Offered

Fall semester

Prerequisites:

ME 3307 - Heat Transfer-II

Course Definition

This is an elective course for Mechanical Engineering Program. The course will cover the basic principles of Renewable Energy.

Course Topics

1. Introduction to Renewable Energy
2. Introduction to Solar Energy
3. Designing of Thermal Solar Collectors
4. Designing of PV System
5. Wind Energy
6. Other Renewable Energy Resources (Hydroelectric ,geothermal ,Biomass, Tidal)
7. Energy Conservation

Course Description:

Non-renewable & Renewable Energy Resources; Advantages of non-conventional energy sources; Disadvantages of non-conventional energy sources. The Physics of Solar Radiation; Sky Radiation; Principal Definitions; Calculation of Radiation Intercepted By Surface Beam Component South Facing Horizontal & Vertical Surface Fixed South Facing Titled Surface. Non-South Facing Titled Surface Total Beam, Diffuse and Reflected Solar Radiation on a Surface Thermal solar collectors (Flat & Concentrating Collectors);Thermal Energy Losses from Solar Collector ;The amount of heat absorbed by the collector ;The amount of useful thermal energy gain from the collector ;Efficiency of Solar Collector. The Principal Working of PV Cell; Calculation the power of the domestic house devices; Calculation the losses power of Inverter &Converter; The number, cost and area of PV panels; The number & cost

of Batteries; The cost of others equipment and accessories of PV System; The total cost of PV System for a single house. Wind Power Plant; The Principal Working of Wind Energy; Calculation Performance of wind turbine; Wind Turbine Classification; Geothermal energy; Electricity production; Flash Power Plant; Dry Steam Power Plant; Binary steam power plant; The Ground-Coupled Heat Pump (GCHS); Hydro power plant; General layout of a hydroelectric power plant; Efficiencies of hydroelectric power turbine ; Classification of hydraulic turbines .; Biomass energy; Biogas Energy; Tidal Energy; Energy Conservation, Energy Tax ;Building Design; Domestic Energy Consumption; Heat Transmission in Building Structures; Design Purpose for Building Space Heating under Iraqi Weather Conditions.

Course Objectives:

The Objectives of this course are to enable students to:

1. Understand the various forms of conventional energy resources
2. Have knowledge on Renewable and Sustainable Energy.
3. Learn the present energy scenario and the need for energy conservation
4. Compare the renewable energy sources with the conventional sources.
5. Be catalyst for awareness about the Renewable Energy and Energy Conservation in the Society.
6. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application.
7. Analyze the environmental aspects of renewable energy resources.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
2. Provide a solid foundation for developing the use of renewable energy systems and . Perform an initial design of a renewable energy system.
3. Know the need of renewable energy resources, historical and latest developments and Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.

4. Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

Recommended Books:

1. John N. Duffie, "Solar Energy Thermal Process" John Wiley & Sons, 2013.
2. Soteris A. Kalogirou, "Solar Energy Engineering Processes and Systems" Academic Press is an imprint of Elsevier, 2014.
3. Peter J. Lunde, " Solar Thermal Engineering" John Wiley & Sons, 1980.

ME 4303E - Finite Element Analysis (2-2-0-0)

Semester Offered

Elective

Prerequisites

1. ME 2306 - Strength of materials-II
2. ME 3307 - Heat Transfer-II
3. ME2305 - Fluid Mechanics-II

Course Definition

This is a required course for the Mechanical Engineering Program. It involves all two types of a course; lecture and tutorial.

Course Topics

1. Introduction
2. Bar Element
3. Beam Element
4. Linear static analysis
5. Two-Dimensional Analysis
6. Finite element for two-dimensional problems
7. Development of Truss Equations
8. Development of Frame and Grid Equations
9. Development of the Plane Stress and Plane Strain Stiffness Equations

10. Isoperimetric Formulation
11. Numerical Quadrature, Three-Dimensional Stress Analysis
12. Finite Element Modelling and Solution Techniques
13. Plate Elements
14. Solid Elements for 3-D Elements
15. Thermal Analysis

Course Description

Introduce the basic fundamentals of the finite element methods. Beginning with simple one-dimensional problem, continuing to two- and three-dimensional elements, and ending with some applications in heat transfer, solid mechanics and fluid mechanics. Covers modelling, mathematical formulation, and computer implementation

Course Objectives

1. The students should understand the mathematical and physical principles underlying the FEA.
2. To provide students with basic skills of FEA programming using Matlab.
3. The formulation of finite element methods for linear static analysis of solids and structures.

Course Learning Outcomes

1. Understand the basic finite element formulation techniques.
2. Be able to derive equations in finite element methods for 1D and 2D problems.
3. Be able to formulate and solve basic problems in heat transfer, solid mechanics and fluid mechanics.
4. Be able to write computer program based on finite element methods.

Lab Experiments

None

Recommended Textbooks

1. Olek C Zienkiewicz, Robert L Taylor, J.Z. Zhu, *The Finite Element Method: Its Basis and Fundamentals*, Sixth Edition, Butterworth-Heinemann 2005

ME 4304E - Computational Fluid Dynamics (2-2-0-0)

ME 4305E - Mechanics of Composite Materials (2-2-0-0)

Semester Offered

Elective

Prerequisites

ME 2306 Strength of Materials-II

Course Definition

Mechanics of composite materials is an elective module for mechanical engineering students in order to develop their knowledge about composite materials. Learn about the various mainstream manufacturing methods, develop a strong understanding of the role of constituents in overall response of composite lamina, and how a set of lamina with different orientations affects the overall laminate properties and response. Finally apply these concepts to analyse and design fibre-reinforced composites for engineering applications.

Course Topics

- Introduction to the history and background of composite materials for engineering applications
- Overview of fibers and resins types
- Overview of manufacturing techniques
- Micromechanics
- Macromechanics
- Failure, analysis, and design of laminates

Course Description

The course covers a broad range of composites materials and their physical and chemical properties, benefits and drawbacks of composites over monolithic materials, discussion of factors that influence mechanical properties of a composite, classification of composites,

manufacturing methods of fibre-reinforced polymer composites and applications of composites. Discussion of recycling of composites. Introduction to terminology used for studying mechanics of composites. A brief review on the fundamentals of solid mechanics and then introducing the concepts required to analyse composite materials. Topics to be discussed include: elastic behaviour and strength of composites, thermal and moisture coefficients, failure analysis, unidirectional lamina and multidirectional laminate, effects of defects, and experimental testing methods.

Course Objectives

The main objective of this course is not only to enlarge the students' knowledge in composite materials but also in their macro/micro mechanical properties to empower the students with the skills needed for the design, manufacture and analysis of composite materials from a material scientist's viewpoint.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
2. Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.
3. Analyse the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites.

Lab Experiments

None

Recommended Textbook(s)

1. Text Book(s): Mechanics of Composite Materials, Second Edition, Autar K. Kaw
2. Recommended Readings: Composite Materials Processing, Applications, Characterizations, Kamal K. Kar
3. Other Resources: Fiberreinforced Composites Materials, Manufacturing, and Design, By: P.K. Mallick 3rd edition

ME 4306E - Fracture Mechanics (2-2-0-0)

Prerequisites

ME 2306 Strength of Materials-II

ME 2304 Engineering Metallurgy

Course Definition

This is an elective Course for the mechanical engineering program.

Course Topics

1. Stress-strain properties.
2. principle stresses and strains
3. brittle vs Ductile fractures
4. theories of elastic failures
5. modes of failures
6. stress intensity factor
7. crack tip plasticity
8. fractures toughness testing
9. COD
10. J. integral
11. Fatigue failure

Course Description

Tensile test, uniaxial loading, Complex stresses and strains, design philosophies (residual stresses, failure analysis) resistance to brittle fracture, ductile fractures, Bridgman's analysis ,Griffith and Irwin theories measuring of G, G for quasi-brittle materials, origin of k, stress-strain fields a head of a crack, critical stress intensity factors (K_c, K_{ic}), practical application of LEFM, ratio Analysis diagram plain strain testing plain stress testing, crack opening displacement J-integral, fatigue failure

Course objective:

1. Try to demonstrate that most fracture events can be predicted through the application of FM.
2. FM was used successfully in design for metallic and brittle materials.
3. Knowing the Service loads (design stresses) on a component or structure with Pre-exist crack.
4. To know what is the maximum crack size that the component or structure can sustain without risk of failure?
5. To know what is the residual strength as a function of crack size?
6. To predict how long does it take for a crack to grow from a certain initial size to the critical size?

Course Learning Outcomes

1. Have a solid foundation in the theory, concepts and principles of fracture mechanics,
2. Gain the physical intuition necessary to idealise a complicated practical problem,
3. Possess the analytical and computational tools needed to solve the idealised problem,
4. Be able to use these solutions to guide a corresponding design, manufacture, or failure analysis and,

Recommended Books:

1. Gdoutos E. E 2015, fracture mechanics: an introduction 2nd edition Springer.
2. Anderson, T.L. 1995 fracture Mechanics fundamental and Applications, 2nd edition, CRC press, USA.

ME 4307E - Aerodynamics (2-2-0-0)

Semester Offered

Fall semester

Prerequisites:

1. ME 3309 Gas Dynamics

Course Definition

This is an elective course for Mechanical Engineering Program. The course will cover the basic principles of Aerodynamics.

Course Topics

1. Aerodynamic forces and moments
2. Center of pressure
3. Streamlines
4. Vorticity
5. Circulation
6. Stream function
7. Potential flow
8. Airfoil characteristics, vortex sheets
9. Thin airfoil theory
10. Flow fields around finite wings
11. Prandtl's lifting-line theory
12. Introduction to compressible flow
13. Velocity potential equation
14. Brief viscous-flow boundary-layer and turbulence concepts

Course Description:

Explores flow over airfoils and wings; ideal flow theory; singularity solutions; superposition; source; and vortex panel methods; method of source panels; 2-D airfoil theory; pressure distributions and lift; effects of compressibility; Prandtl's lifting-line theory; boundary-layer theory; and friction drag. Considering airfoil characteristics, and boundary-layer measurements.

Course Objectives:

This course covers concepts of subsonic aerodynamics for students of aerospace engineering. Its objective is to present theoretical aerodynamics with basic numerical applications of potential flow over basic configurations: airfoil, swept lifting surface, fixed and rotating, and over body of revolution. Furthermore, compressibility effects are considered as well as

elementary analysis of the uncompressible boundary layer including boundary layer transition and turbulent layer.

Course Learning Outcomes:

By the end of successful completion of this course, the student will be able to:

1. Understand the physical mechanisms underlying the aerodynamics of airfoils and wings.
2. Apply the appropriate governing equations and assumptions to analyze airfoils and wings, and obtain aerodynamic forces and moments.
3. Identify the effects of parameters such as airfoil shape, wing aspect ratio, and compressibility on performance.
4. Incorporate aspects such as fuel efficiency and cost into performance calculations, to consider environmental and economic factors.
5. Have an introductory knowledge of the experimental facilities and methods used to measure airfoil characteristics.
6. Have an introductory understanding of the computational methods used to analyze airfoils and wings.
7. Produce an aerodynamic design to meet specified requirements and constraints, including environmental and economic considerations, using the skills identified above.

Recommended Books:

1. Anderson, J. D., Fundamentals of Aerodynamics, 6th Edition, McGraw-Hill, NY (2016).

ME 4308E - Artificial Intelligence (2-2-0-0)

Course Definition

Studying the basic principles of Artificial Intelligence. The topics may include: AI methodology and fundamentals; intelligent agents; search algorithms; game playing; supervised and unsupervised learning; decision tree learning; neural networks; nearest

neighbour methods; dimensionality reduction; clustering; kernel machines; support vector machines; uncertainty and probability theory; probabilistic reasoning in AI; Bayesian networks; statistical learning; fuzzy logic. Several assignments will be given to enable the student to gain practical experience in using these techniques.

Course Topics

Introduction to AI , search algorithm , supervised and unsupervised learning, neural networks , fuzzy logic and Probabilistic reasoning in AI

Course Description:

This is an introductory course on Artificial Intelligence. The topics may include: AI methodology and fundamentals; intelligent agents; search algorithms; game playing; supervised and unsupervised learning; decision tree learning; neural networks; nearest neighbour methods; dimensionality reduction; clustering; kernel machines; support vector machines; uncertainty and probability theory; probabilistic reasoning in AI; Bayesian networks; statistical learning; fuzzy logic. Several assignments will be given to enable the student to gain practical experience in using these techniques.

Course Objectives:

1-This course provides an introduction to AI

2- This introduction is followed by development of the data representation

3-The goal is to provide a foundation for understanding the search algorithm

Course Learning outcomes

On successful completion of this course students will be able to:

1- Explain what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.

2- Explain how Artificial Intelligence enables capabilities that are beyond conventional technology, for example, chess-playing computers, self-driving cars, robotic vacuum cleaners.

3- Use classical Artificial Intelligence techniques, such as search algorithms, minimax algorithm, neural networks, tracking, robot localisation.

4- Ability to apply Artificial Intelligence techniques for problem solving.

5- Explain the limitations of current Artificial Intelligence techniques.

References

Russell, Norvig. Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.

Prerequisites:

ME3201 Engineering statistics

ME 4309 E-Computer Aided Design/Computer Aided Manufacturing CAD/CAM (2-2-0-0)

Semester Offered

Fall semester

Prerequisites

1- ME 1301- Principles of Manufacturing Process.

2- ME 3201- Engineering Statistics.

3- ME 3310 – Industrial Engineering and Economic Analysis.

Course Definition

The course will provide an overview of how computer-aided design and computer-aided manufacturing can be applied to the traditional skills of modelling, manufacturing, lay planning and assembly

Course Topics

1- CAD/CAM definition

2- 2D modelling: wire frame modelling

3- Curve modelling: Furgson curve, Bezier curve, spline curve

4- 3D- modelling

A- Constructive geometry

B- Boundary geometry

C- Solid Geometry

5- CAM activities and coding

6- Computer aided process planning and group technology

7- Robotics

Course Description

This is an introductory course that demonstrates the integration of Computer-Aided-Design (CAD) and Computer-Aided-Manufacturing (CAM). It is a study of modern prototyping and machining methods, teaching the use of Master CAM software. This program converts 2D and 3D CAD drawing geometry directly into tool path information that is used to drive numerically controlled turning and milling machines.

Course Objectives

- Create 2D and 3D part geometry using the design module of the Master CAM software.
- Use the mill module of the Master CAM software to convert the modeled part geometry into a cutter tool path for use on a numerically controlled milling machine.
- Use the lathe module of the Master CAM software to convert the modeled part geometry into a cutter tool path for use on a numerically controlled lathe.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. An understanding of the theory of orthographic projection and the conventions associated with mechanical engineering drawings, and to apply this understanding to interpret and to create mechanical engineering drawings of components and assemblies;

Addresses ABET outcomes (a), (g), (k)

Assessment: Assignments, Examination, student survey.

2. Proficiency in the use of a modern computer-aided design program (SolidWorks), including (a) creation of parametric solid models of components and assemblies; (b) creation of mechanical engineering drawings; (c) creation of photorealistic renderings; (d) structural and kinematic simulations.

Addresses ABET outcome (k) Assessment: Assignments, Examination, student survey.

3. The ability to apply computer-aided design techniques to complete all phases of a top-down mechanical engineering design process (Describe the product development process, Express product design ideas using 2D sketches, Model a component with complex shapes, Model an assembly of components with kinematic linkages, Render and animate the appearance and functionality of a product), and to use computer-aided visualization techniques to prepare and deliver written and oral presentation of design specifications.

Lab Experiments:

No Lab

Recommended Textbook(s)

1- CAD/CAM by Groover 2011
2- CAD by Chein 2008
3- Robotics and automation by Groover 2012

ME 4310E - Corrosion Engineering (2-2-0-0)

Course Definition

Studying the basic principles of corrosion, corrosion types and prevention fro industrial application.

Course Topics

Introduction to corrosion, electrochemical corrosion, types of corrosion rate, passivation Electrochemical Thermodynamics and Electrode Potential. Electrochemical Kinetics of corrosion. Passivity, Polarization Methods to Measure Corrosion Rate Galvanic and Concentration Cell Corrosion, Pitting and Crevice Corrosion, Effects of Metallurgical Structure ,Review Phase Diagrams, Review Ferrous Metals, Environmentally Induced Cracking.

Course description:

Corrosion principles; electrochemical, environmental, and metallurgical effects; types of corrosion; corrosion testing and prevention; modern theories: principles and applications.

Course objectives:

1-This course provides an introduction to the principles of electrochemistry as well as the essential elements of electrochemical corrosion.

2- This introduction is followed by development of the thermodynamic and kinetic aspects of electrochemistry, including

potential-pH (Pourbaix) diagrams, mixed potential theory, and the theory and application of passivity.

3-The goal is to provide a foundation for understanding the forms of

corrosion, the mechanisms of corrosion, electrochemical methods

4- to study and measure corrosion, and the principles and methods leading to mitigation of corrosion problems that might occur in engineering practice.

Course Learning Outcomes:

1. To gain information about different corrosion types
2. To gain information about electrochemical reactions
3. To gain knowledge about the passivation
4. An ability to understand the theory of thermodynamics and kinetics
5. To understand the principle of corrosion rate methods
6. To gain knowledge about the advance methods of preventions

Textbook:

D.A. Jones, Principles and Prevention of Corrosion, 2nd edition, Prentice Hall, 1996.

References

Zaki Ahmad, Principles of Corrosion Engineering and Corrosion Control, Butterworth-Heinemann/I/ChemESeries (Elsevier), 2006.

William D. Callister, Jr., Materials Science and Engineering: An Introduction, 9th edition, Wiley, 2013.

Metals Handbook, Vol 13, Corrosion, American Society for Metals International, 1987.

ME 4311E - Design of Heat Exchangers (2-2-0-0)

Semester Offered (Fall – Spring)

Fall semester

Prerequisites

ME 3307 Heat Transfer-II

Course Definition

Process design of heat exchanger: types of heat exchanger, process design of shell and tube heat exchanger, condenser and re-boilers.

Course Topics

The topics that will cover in this course will be:

Process design of shell and tube exchanger for single-phase heat transfer

1. Heat Exchangers Classifications
2. Thermal Design Considerations
3. Process (Thermal) Design Procedure
4. Design Problems

Process design of shell and tube exchanger for two-phase heat transfer

1. Condenser
2. Condenser design
3. Condenser and Reboiler Design
4. De-superheating and sub-cooling
5. Reboilers
6. Design of kettle reboiler
7. Design Problems

Course Description

Classification of heat exchangers, Thermal design considerations, Process (thermal) design procedure, Design problems Condenser, Types of condensers, Condenser design, De-superheating and sub-cooling. Reboilers, Classification of reboilers, Design of Kettle reboiler, Thermal design considerations, Selection of fluids for tube and the shell side,

Process (thermal) design procedure. Mechanical design provided in module, Types of condensers, Condenser design, Condenser and Reboiler. Design De-superheating and sub-cooling, Design of kettle reboiler, Design problems.

Course Objectives

1. To understand Process design of shell and tube exchanger for single-phase heat transfer.
2. To recognize classification of heat exchangers.
3. To understand thermal design considerations.
4. To understand Process design of shell and tube exchanger for two-phase heat transfer.
5. To recognize classification of reboilers.
6. To understand design of Kettle reboiler.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Know the definitions of fundamental concepts of shell and tube exchanger for single-phase heat transfer.
2. Apply the basic equation of thermal design considerations to determine thermal efficiency and performance.
3. Introduce the main design problems of heat exchangers.
4. Uses of conservation laws and convection heat transfer and apply them to determine the key considerations of condenser design.
5. Uses of conservation laws and convection heat transfer and apply them to determine the key considerations of Kettle reboiler.

Lab Experiments:

There is no Lab. with this module.

Recommended Textbooks

1. P. Incropera and D. P. Dewitt, "*Fundamentals of Heat and Mass Transfer*", McGraw-Hill series in mechanical engineering, 2011.

2. Yunus A. Cengel, "*Heat Transfer, A Practical Approach*", McGraw-Hill series in mechanical engineering, 2nd Edition, 2012.
3. Indian Standard "(IS: 4503-1967): *Specification for Shell and Tube Type Heat Exchangers*", BIS 2007, New Delhi, 2007.
4. R. K. Sinnott, Coulson & Richardson, "*Chemical Engineering: Chemical Engineering Design* (volume 6)", Butterworth-Heinemann, 3rd Edition, 1999.
5. Q. Kern, "*Process Heat Transfer*", McGraw-Hill Book Company, Int. Edition, 1965.
6. Dutta B.K. "*Heat Transfer-Principles and Applications*", PHI Pvt. Ltd., New Delhi, 1st Edition, 2006.
7. James R. Couper; W. Roy Penney, James R. Fair, Stanley M. Walas, "*Chemical Process Equipment: selection and design*", Elsevier Inc., 2nd Edition, 2005.

ME 4312–Electromechanics & Electronics (2-2-0-0)

Semester Offered (Fall– Spring)

Fall semester

Prerequisites

ME 1206- Fundamentals of Electrical Engineering.

ME 2311Electrical Machines.

Course Definition

This is a required course for Mechanical Engineering Program. Refers to the analysis, design, manufacture and maintenance of equipment and products based on the combination of electrical/electronic circuits and mechanical systems.

Course Topics

1. Introduction to Electromechanical systems.
2. Mechanical Engineering subsystems.
3. Electrical and electronics controller.
4. Interaction of electrical, electronic and mechanical systems.

Course Description

Electromechanics and Electronics focuses on the interaction of electrical, electronic, and mechanical systems as a whole and how the two systems interact with each other. Electromechanical devices are ones which have both electrical and mechanical processes. The term is usually understood to refer to devices which involve an electrical signal to create mechanical movement, or vice versa mechanical movement to create an electric signal. Often involving electromagnetic principles such as in relays, which allow a voltage or current to control another, usually isolated circuit voltage or current by mechanically switching sets of contacts, and solenoids, by which a voltage can actuate a moving linkage as in solenoid valves.

Course Objectives

1. To introduce an overview on electromechanical systems.
2. To study the interaction of electrical, electronic, and mechanical systems.
3. To apply electrical and mechanical process.
4. To study the use of electronics to automate the electromechanical process.

Course Learning Outcomes

1. Understand the basic concepts of electromechanical systems.
2. Describe the different parts of electromechanical systems which are mechanical, electrical, and electronic.
3. understand the interaction of electrical, electronic, and mechanical systems.
4. Describe the using of electronic devices to control the operation electrical and mechanical process.

Recommended Textbooks

The Electrical Engineering Handbook By Wai-Kai Chen.

Electromagnetic and Electromechanical Engineering Principles Notes 01 Basics Marc T. Thompson, Ph.

ME 4313E- Engineering Biomechanics (2-2-0-0)

Semester Offered

Elective

Prerequisites

Graduate standing or permission of the instructor. Senior undergraduates are encouraged to seek entry.

Course Definition

The biomechanics and mechanobiology of the musculoskeletal system in human beings and other vertebrates on the level of the whole organism, organ systems, tissues, and cell biology. Emphasis is on the interactions between mechanical and chemical factors in the regulation of connective tissue biology. Structure/function relationships and mechanical properties of soft tissues, including nonlinear elasticity, viscoelasticity, and poroelasticity. Experimental techniques to study human and animal movement including motion capture systems, EMG, force plates, medical imaging, and animation. The mechanical properties of muscle and tendon, and quantitative analysis of musculoskeletal geometry.

Commonly used medical devices in different medical specialties. Guest lecturers include Anbar Medical School physicians, entrepreneurs, and venture capitalists. How to identify clinical needs and design device solutions to address these needs. Fundamentals of starting a company. In collaboration with the School of Medicine. Introduction to medical device design for undergraduate and graduate engineering students. Design and prototyping. Labs; medical device environments including hands-on device testing; and field trips to local medical device companies; workshops, labs. No previous engineering training required.

While in school, it's a good idea to get as much practical experience as possible. Preference to senior admitted if space available. Application required.

Course Topics

1. The musculoskeletal system
2. Kinematics and loads
3. Tissue mechanics
    - Bone
    - Tendons and ligaments
    - Muscle
    - Articular cartilage
    - Intervertebral Disc

4. Symmetric and unsymmetric beams
    - Bending
    - Tension and compression
    - Torsion
5. Bio-compatible materials
6. Contact stress
7. Orthopaedic and biomechanical literature; statistics and levels of evidence
8. Design of experiments

Course Description

Current methods for analysis of biomechanical systems that include bone, tendon, ligament, cartilage, and other soft tissue. Mechanics that govern biomechanical systems including beam theory, anisotropic materials, viscoelasticity, and con-tact. Also prosthetics, orthotics, and other medical devices.

Course Objectives

To provide an educational program that will prepare graduates to:

1. Participate as a technical contributor and member of a design.
2. Communicate effectively with individuals and teams with a wide variety of backgrounds.
3. Pursue professional or graduate degrees or employment in the biomedical industry.
4. Understand the legal, ethical, economic, and regulatory requirements of medical device design and biomedical engineering research.
5. Define, solve and implement solutions to a problem.
6. Progress in developing leadership skills.
7. Identify limitations in their own knowledge base and skills and engage in lifelong learning.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. Identify appropriate analytical models to describe and solve an actual industrial biomechanical or biomaterial design problem.
2. Improve health in the service of humanity by discovering and disseminating new knowledge.

3. Guiding students to meaningful and ethical professional and personal lives.
4. Fostering interdisciplinary and collaborative research and education through academic and industrial alliances.
5. Continuing innovative leadership in education, research, and industrial relationships.
6. Inspiring faculty and students to serve others.
7. Reduce the behavior of complex elements into appropriate sub- systems/elements and then analyses the behavior of their elements.
8. Apply stress analysis theory, fatigue theory and appropriate criteria of failure to the design of simple biomechanical or biomaterial design problem.
9. Use proper assumptions with respect to material, factor of safety, static and dynamic loads for various machine components.

Lab Experiments:

No Lab

Recommended Textbooks

1. Orthopaedic Biomechanics, Bartel, Davy, and Keaveny. Pearson Prentice Hall Publishing.
2. Biomechanics of the Musculo-skeletal System Benno M. Nigg and Walter Herzon, editors. Wiley Press, 2007

ME 4314E- Operation Research (2-2-0-0)

Semester Offered (Fall – Spring)

Fall semester

Prerequisites

1. **ME 3310E** Industrial Engineering and Economic Analysis

Course Definition

This is a Selective Course for the mechanical engineering program.

Course Topics

1. Liner Programming Methods,
2. L.P Graphical Method,
3. L.P Algebraic Method,
4. L.P Simplex Method,
5. Transportation Method,
6. Assignment Method,
7. Applications of Network,
8. Queuing Theory,
9. Games Theory,
10. Sequencing.

Course Description

This course focuses on the application of linear programming techniques. Most of the mathematical models presented in the course are normal prescriptive or optimization applications. The models include the Diet, Work-Scheduling, Capital Budgeting, ShortTerm Financial Planning, Blending, Multi-period Decision (Inventory model), Multi-period Financial Model, and Multi-Period Work Scheduling. The course includes discussions of the simplex algorithm and other methods to derive solutions for the above models. The Excel Solver software is also used in the course to solve linear programming problems. Discussions (Sensitivity Analysis) are included as to how changes or variations in a linear programming's parameters affect the optimal solution.

Course Objectives

1. Understand how to model and solve problems using dynamic programming.
2. Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
3. Understand the relationship between a linear program and its dual, including strong duality and complementary slackness.
4. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
5. Solve specialized linear programming problems like the transportation and assignment problems.

6. Solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
7. Understand the applications of, basic methods for, and challenges in integer programming.
8. Model a dynamic system as a queuing model and compute important performance measures.
9. Learn optimality conditions for single- and multiple-variable unconstrained and constrained nonlinear optimization problems, and corresponding solution methodologies.

Course Learning Outcomes

By the end of successful completion of this course, the student will be able to:

1. construct linear programming models and discuss the solution techniques .
2. formulate and solve problems as networks and graphs.
3. set up decision models and use some solution methods for nonlinear optimization problems
4. propose the best strategy using decision making methods under uncertainty and game theory.
5. solve multi-level decision problems using dynamic programming method.
6. Prepare a team-based project about heuristics /meta-heuristics algorithms used to solve integer or nonlinear programming problems.

Lab Experiments:

NA

Recommended Textbooks

1. Hiller, F.S. and Lieberman, G.J., Introduction to Operations Research (9th ed.), McGraw-Hill, 2009.

2. Winston, W.L., Introduction to Mathematical Programming (4th ed.), Duxbury Press, 2002.

3. Hamdei, T., "operation researches "(8th ed.) McGraw-Hill, 2009.