Ministry of Higher Education and Scientific Research

UNIVERSITY OF ANBAR

COLLEGE OF ENGINEERING

MECHANICAL ENGINEERING DEPARTMENT

MECHANICAL ENGINEERING DEPARTMENT

COLLEGE OF ENGINEERING - UNIVERSITY OF ANBAR

HANDBOOK

UNDERGRADUATE

2023-2024

Preface

This Mechanical Engineering (ME) handbook is prepared to orient and guide students through their ME educational experience. It serves 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.

Table of Contents

Vision 1
Mission 1
Goals 1
Mechanical Engineering Program 1
Enrolment and Graduation Rates 2
Program Educational Objectives (PEOs) 3
Student Learning Outcomes (SLO's) 3
ABET Student Outcomes (SO's) 4
Iraqi National Accreditation Criteria (ICAEE) 5
Graduate Outcomes (GO's) 5
Linking PEO's to GO's 6
The relation between college PEO's, SLO's, and GO's 7
The relation between college SO's and PEO's 8
The relation between college PEO's and SLO's 8
Relation between College SO's and SLO's 9
Course Description 10
Courses and Credit Hours for Mechanical Engineering Department 11
Graduation Requirements 11
University Requirements (18 credit hours) 11
College Requirements (36 credit hours) 11
Department Requirements: 86 Credit hours 12
Elective Courses (Max 6 Credit Hours) 13
MED Courses 14

ME Program Outcome Curriculum Map According to NGO's Criterion 16

Program Outcome Curriculum Map According to 18

ABET Criterion 18

Program Outcome Curriculum Map According to SLO's Program 20

University Requirements Courses 23

UOA 003 - English Language I (2-2-0-0) 23
UOA 005 - Human Rights and Democracy (2-2-0-0) 24
UOA 001 - Arabic Language (2-2-0-0) 24
ME 2101 - English Language II (2-2-0-0) 25
ME 3101- English Language-III (2-2-0-0) 26
ME 3102 - Ethics and Leadership Skills (2-2-0-0) 29
ME 4101 - English Language -IV (2-2-0-0) 30
UOA 007 - Computer science I (2-1-0-2) 33
UOA 006 - The Crimes of Baath Regime in Iraq (2-2-0-0) 34

COLLEGE REQUIREMENT COURSES 35

ENG 003– Calculus-I (3-3-1-0) 35
ENG 001– Physics (4-3-0-2) 36
ENG 002– Chemistry (4-3-0-2) 37
ENG 006– Engineering Mechanics I (Statics) (3-3-1-0) 38
ENG 005- Fundamentals of Electrical Engineering (3- 2- 1- 2) 40
ENG 004– Calculus-II (3-3-1-0) 41
ENG 007– Engineering Drawing (3-2-2-2) 42
ME 2201 – Calculus-III (3-3-1-0) 43
ME 2202 – Calculus-IV (3-3-1-0) 45
ME 3201- Engineering Statistics (3-3-0-0) 47
ME 3202 – Engineering Numerical Methods (4-3-0-2) 50

DEPARTMENT REQUIREMENT COURSES 53

MEC 001– Principles of Manufacturing Process (3-2-2-2) 53
ME2301 - Fluid Mechanics-I (3-2-1-2) 55
ME 2302 - Strength of Materials-I (3-2-1-2) 56
ME 2303 – Thermodynamics-I (3-2-1-2) 58

ME 2304 - Engineering Metallurgy (3-2-1-2) 59
ME 2305 - Fluid Mechanics-II (3-2-1-2) 60
ME 2306 - Strength of Material-II (3-2-1-2) 62
ME 2307 – Thermodynamics-II (3-2-1-2) 63
MEC 002 & ME 2308 – Engineering Mechanics II (Dynamics) (2-2-1-0) 65
ME 2309 - Mechanical Drawing (3-2-1-2) 66
MEC 003 & ME 2310 - Computer Programming (2-1-0-2) 67
ME 2311–Electrical Machines (3-2-0-2) 68
ME 3301 - Engineering Analysis (4-4-0-0) 70
ME 3302 - Heat Transfer-I (3-2-1-2) 71
ME 3303-Theory of Machines-I (3-2-1-2) 72
ME 3304 - Internal Combustion Engines-(2-2-1-0) 74
ME 3305 - Manufacturing Processes (2-2-1-0) 75
ME 3306 - Research Methodology (1-1-0-0) 76
ME 3307 - Heat Transfer-II (3-2-1-2) 77
ME 3308 - Theory of Machines-II (3-2-1-2) 78
ME 3309 - Gas Dynamics (2-2-1-0) 80
ME 3310 - Industrial Engineering and Economic Analysis (2-2-1-0) 81
ME 4301- Design of Machine Elements-I (3-3-1-0) 83
ME 4302 - Air Conditioning (3-2-1-2) 84
ME 4303 - Power Plant (3-3-0-0) 85
ME 4304 - Mechanical Vibrations (3-2-1-2) 87
ME 4306- Design of Machine Elements-II (3-3-1-0) 89
ME 4307-Refrigeration (3-2-1-2) 90
ME 4308 - Engineering Materials (2-2-1-0) 92
ME 4309 - Control Systems (3-2-2-2) 93
ME 4305 – Final Year Project I (2-2-1-0) 94
ME 4310 – Final Year Project II (2-2-1-0) 96
Fourth Year Elective Courses 97
ME 4301E - Computer Applications (2-2-0-0) 97
ME 4302E - Renewable Energy (2-2-0-0) 98
ME 4303E - Finite Element Analysis (2-2-1-0) 100
ME 4304E - Computational Fluid Dynamics (CFD) (2-1-1-2) 101

ME 4305E - Mechanics of Composite Materials (2-2-0-0) 102
ME 4306E - Fracture Mechanics (2-2-0-0) 103
ME 4307E - Aerodynamics (2-2-0-0) 105
ME 4308E - Artificial Intelligence (2-2-0-0) 106
ME 4309E - Computer Aided Design (CAD)/Computer Aided Manufacturing (CAM) (2-2-0-0) 107
ME 4310E - Corrosion Engineering (2-2-0-0) 108
ME 4311E - Design of Heat Exchangers (2-2-0-0) 109
ME 4312E - Electromechanics & Electronics (2-2-0-0) 111
ME 4313E - Engineering Biomechanics (2-2-0-0) 112
ME 4314E - Operation Research (2-2-0-0) 114

Vision

The Department of Mechanical Engineering endeavors to be one of the leading Mechanical Engineering programs in order to improve and serve local and global communities.

Mission

The Department of Mechanical Engineering's mission aims to contribute to high-quality education in Mechanical discipline and encourage scientific research that helps to solve mechanical problems by employing modern technology creating and advanced knowledge.

Goals

The Mechanical Engineering program provides graduates with solid practical and professional knowledge to excel in this field of engineering through:

1. Provide a high quality of mechanical engineering education via outstanding teaching, innovative curriculum, and career-relevant training programs.
2. Encourage and promote execution innovative research and find solutions for the complex problems related to mechanical engineering.
3. Prepare mechanical engineers adhered to the professional ethics, applicable laws and the accepted standards to prevent corruption and deviation.
4. Promote the quality of education and scientific research for the academic staff and employees of the department.
5. Offer mechanical engineering consulting services that satisfy a community's and an institution's requirements.

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 goals. Thus, graduates of the Mechanical Engineering Program will have:

The ability to apply knowledge of mathematics, science, and engineering to design and conduct experiments, as well as to analyze and interpret data;

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;

To understand the impact of engineering solutions in a global, economic, environmental, and societal context.

The ability to communicate effectively and engage in life-long learning.

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	73	40
2006-2005	36	101	2022-2023	64	32

Program Educational Objectives (PEOs)

PEO-1: Successful Professionals

Be successful professionals in Mechanical Engineering and related fields.

PEO-2: Ethics and Standards

Be adhered to the professional ethics and the accepted standards.

PEO-3: Leadership, communication, and collaboration

Purse leadership roles and demonstrate effective communication and collaboration in their workplace and the society.

PEO-4: Lifelong learning

Peruse lifelong learning through continued development of their technical and professional skills. Pursue graduate education and research at major research universities in Mechanical engineering and related fields.

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)
Graduate Outcomes (GO's)

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

NGO-ii: An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.

NGO-iii: An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions.

NGO-iv: An ability to communicate effectively with a range of audiences.

NGO-v: 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.

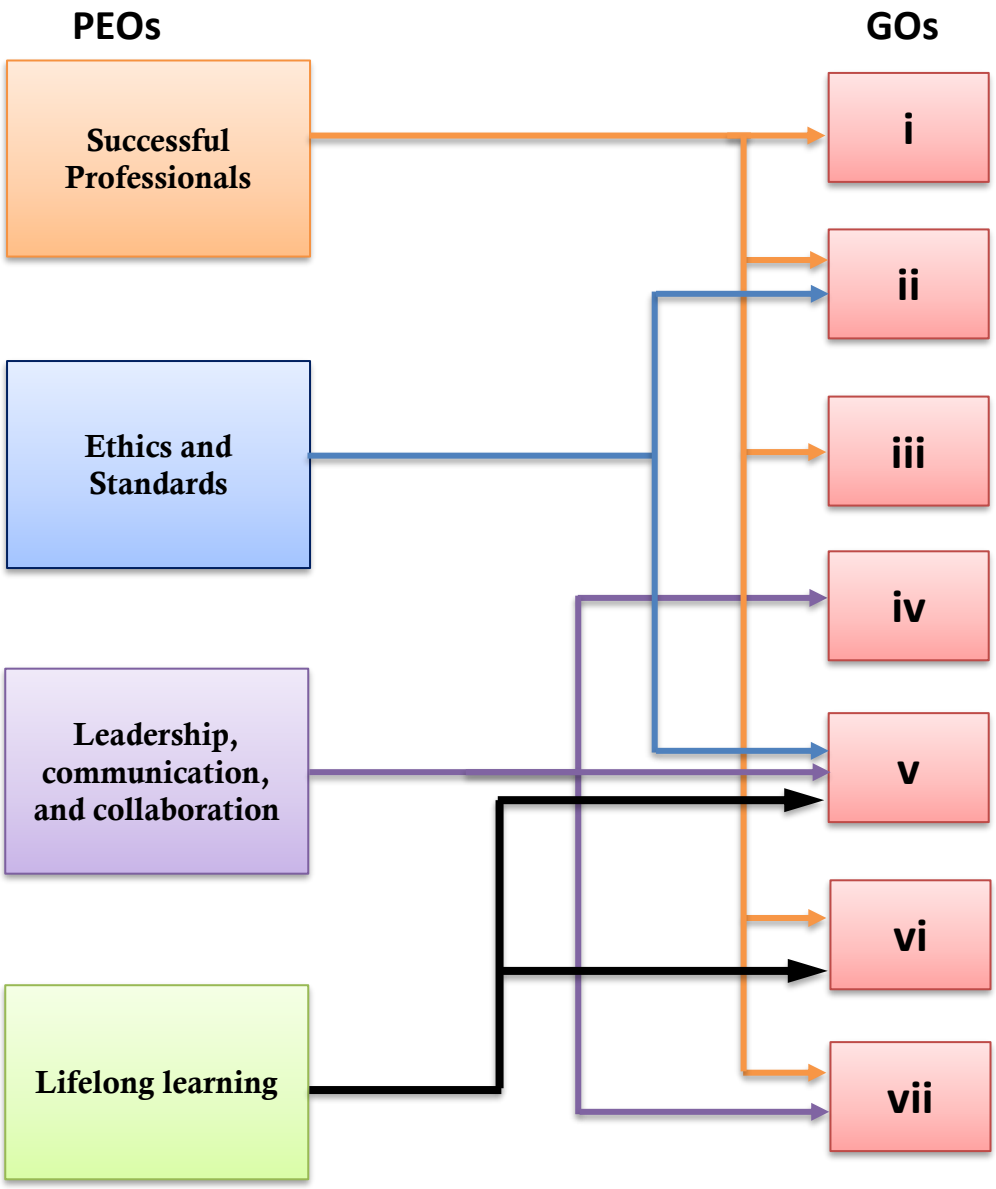
NGO-vi: An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.

NGO-vi: An ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.

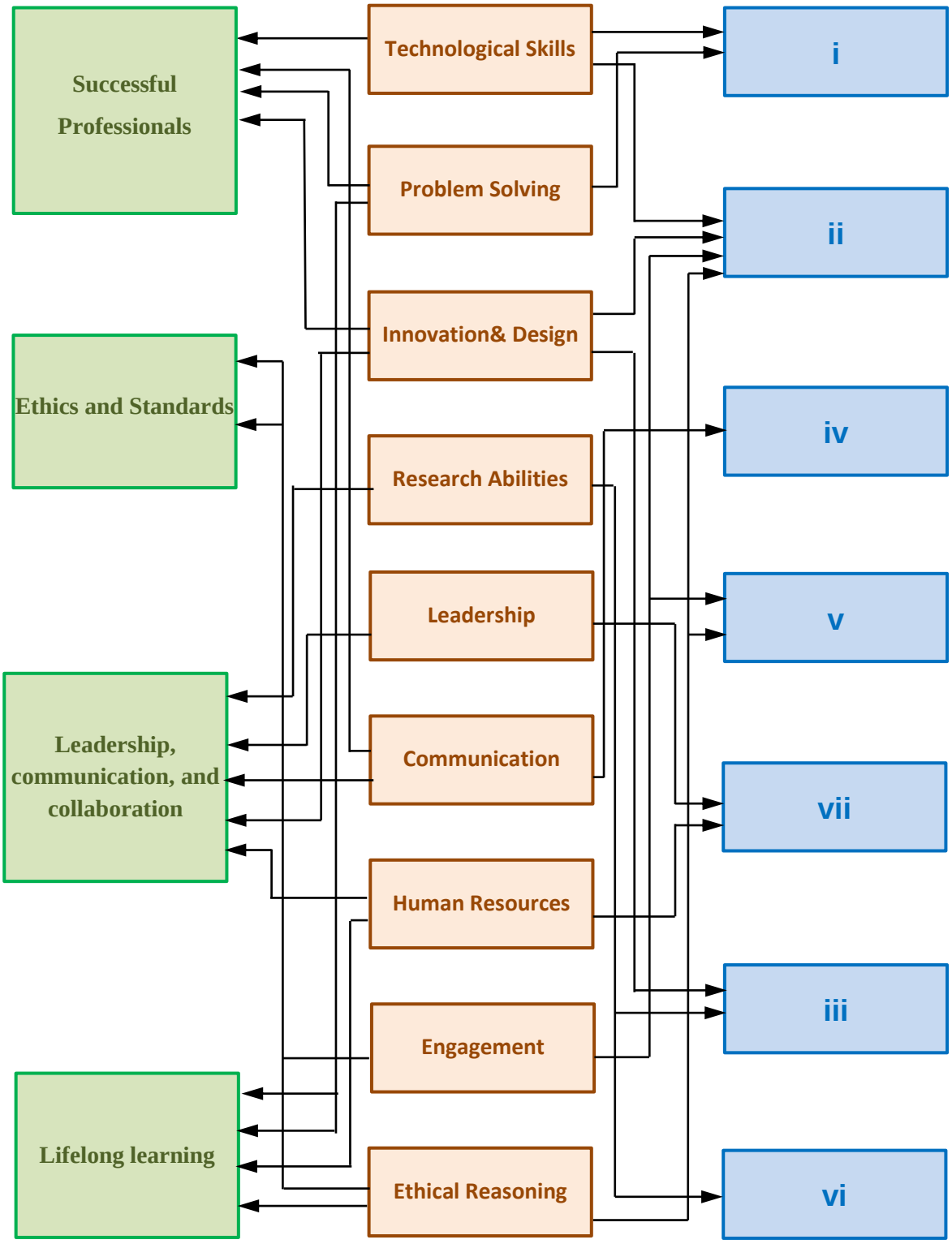
Relation between SO's (ABET) and GO's (ICAEE)

SO's (ABET) / GO's (ICAEE)						
1/i	2/ii	3/iv	4/v	5/vii	6/iii	7/vi

Linking PEO's to GO's



The relation between college PEO's, SLO's, and GO's



The relation between college SO's and PEO's

SOs	PEOs			
	Successful Professionals	Ethics and Standards	Leadership, communication, and collaboration	Lifelong learning
1	✓		✓	
2	✓	✓		✓
3	✓			
4		✓	✓	
5			✓	✓
6			✓	✓
7			✓	

The relation between college PEO's and SLO's

PEOs	SLOs								
	Technological Skills	Problem-Solving abilities	Innovation & Design	Research Abilities	Leadership	Communication	Human-Resources & Interaction	Engagement	Ethical Reasoning Behaviour
Successful Professionals	✓					✓			
Ethics and Standards									✓
Leadership, communication, and collaboration			✓	✓	✓	✓	✓	✓	
Lifelong learning	✓	✓	✓						

Relation between College SO's and SLO's

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:

There are two-system numbering:

1. Bologna Process for first year

Course code:
UOA 001, UOA 002, UOA 003, …. (University requirement)
ENG 001, ENG 002, ENG 003, …. (College requirement)
MEC 001, MEC 002, MEC 003, …. (Department requirement)

2. For the rest of years:

Course code = **ME0000**
The number consists of **4** digits as following:
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	18
College Requirements	36
Department Requirements	86
ME Elective Classes	06
Total	146

University Requirements (18 credit hours)

Course Number	Course Title	Credit Hours	Weekly Hours
UOA 001	Arabic Language I	2	2
UOA 003	English Language I	2	2
UOA 005	Human Rights and Democracy	2	2
UOA 007	Computer Science I	2	2
UOA 006	The Crimes of Baath Regime in Iraq	2	2
ME 2101	English Language- II	2	2
ME 3101	English Language -III	2	2
ME 3102	Ethics and Leadership Skills	2	2
ME 4101	English Language- IV	2	2
Total		18	18

College Requirements (36 credit hours)

Course Number	Course Title	Credit Hours	Weekly Hours		
			Lec.	Tut.	Lab
ENG 001	Physics	4	3	0	2
ENG 002	Chemistry	4	3	0	2
ENG 003	Calculus I	3	3	1	0
ENG 004	Calculus II	3	3	1	0
ENG 005	Fundamentals of Electrical Engineering	3	2	1	2
ENG 006	Engineering Mechanics I (Static)	3	3	1	0
ENG 007	Engineering Drawing	3	2	2	2
ME 2201	Calculus -III	3	3	1	0
ME 2202	Calculus- IV	3	3	1	0
ME 3201	Engineering Statistics	3	3	0	0
ME 3202	Engineering Numerical Methods	4	3	0	2
Total		36	31	8	10

Department Requirements: 86 Credit hours

Course Code	Course Title	Credit hours	Weekly hours		
			Lec.	Tut.	Lab
MEC 001	Principles of Manufacturing Process	3	2	2	2
MEC 002	Engineering Mechanics-II(Dynamics)	2	2	1	0
MEC 003	Computer Programming	2	1	0	2
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)	0	0	0	0
ME 2309	Mechanical Drawing	3	2	1	2
ME 2310	Computer Programming	0	0	0	0
ME 2311	Electrical Machines	3	2	0	2
ME 3301	Engineering Analysis	4	4	0	0
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	1	0
ME 3305	Manufacturing Processes	2	2	1	0
ME 3306	Research Methodology	1	1	0	0
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	0
ME 3310	Industrial Engineering and Economic Analysis	2	2	1	0
ME 4301	Design of Machine Elements -I	3	3	1	0
ME 4302	Air Conditioning	3	2	1	2
ME 4303	Power Plants	3	3	0	0
ME 4304	Mechanical Vibrations	3	2	1	2
ME 4305	Final Year Project- I	2	2	1	0
ME 4306	Design of Machine Elements -II	3	3	1	0
ME 4307	Refrigeration	3	2	1	2
ME 4308	Engineering Materials	2	2	1	0
ME 4309	Control Systems	3	2	2	2
ME 4310	Final Year Project- II	2	2	1	0
Total		86	67	30	38

Elective Courses (Max 6 Credit Hours)

Course Number	Course Title	Credit Hours	Weekly Hours		
			Lec.	Tut.	Lab
ME 4301E	Computer Applications	2	1	1	2
ME 4302E	Renewable Energy	2	2	1	
ME 4303E	Finite Element Method	2	2	1	
ME 4304E	Computational Fluid Dynamics	2	1	1	2
ME 4305E	Mechanics of Composite Materials	2	2	1	
ME 4306E	Fracture Mechanics	2	2	1	
ME 4307E	Aerodynamics	2	2	1	
ME 4308E	Artificial Intelligence	2	2	1	
ME 4309E	CAD/CAM	2	2	1	
ME 4310E	Corrosion Engineering	2	2	1	
ME 4311E	Design of Heat Exchangers	2	2	1	
ME 4312E	Electromechanics & Electronics	2	2	1	
ME 4313E	Engineering Biomechanics	2	2	1	
ME 4314E	Operation Research	2	2		

Requirements	Credit Hours	Weekly hours		
		Lec.	Tut.	Lab
University Requirements	18	18	0	0
College Requirements	36	31	8	10
Department Requirements	86	67	30	38
ME Elective Classes	06	06	0	0
Total	146	122	38	48
		208		

Total Weekly Credit Hours = 146 **Total Weekly Hours = 208**

Total Contact Hours / Semester = 3120 (Weekly hours*15 weeks)

MED Courses

First Year (Freshman)

Semester I (Fall Semester)

Course Code	Course Title	Weekly Hours			ECTS	Credit Hours
		Theoretical	Tutorial	Practical		
ENG 003	Calculus I	3	1	0	6	3
ENG 006	Engineering Mechanics I (Static)	3	1	0	6	3
ENG 001	Physics	3	0	2	5	4
MEC 001	Principles of Manufacturing Process and Workshops	2	2	2	6	3
UOA 001	Arabic Language I	2	0	0	2	2
UOA 005	Human Rights and Democracy	2	0	0	2	2
UOA 007	Computer Science I	1	0	2	3	2
Total Hours and Credit Hours		16	4	6	30	19
		26				

Semester II (Spring Semester)

Course Code	Course Title	Weekly Hours			ECTS	Credit Hours
		Theoretical	Tutorial	Practical		
ENG 004	Calculus II	3	1	0	6	3
ENG 005	Fundamentals of Electrical Engineering	2	1	2	6	3
ENG 007	Engineering Drawing	2	2	2	5	3
ENG 002	Chemistry	3	0	2	5	4
MEC 002	Engineering Mechanics-II(Dynamics)	2	1	0	4	2
MEC 003	Computer Programming	1	0	2	2	2
UOA 003	English Language I	2	0	0	2	2
Total Hours and Credit Hours		15	5	8	30	19
		28				

Second Year (Sophomore)

Semester I (Fall Semester)

Course Code	Course Title	Weekly Hours			Credit Hours
		Theoretical	Tutorial	Practical	
ME 2201	Calculus-III	3	1	0	3
ME 2301	Fluid Mechanics-I	2	1	2	3
ME 2302	Strength of Materials-I	2	1	2	3
ME 2303	Thermodynamics-I	2	1	2	3
ME 2309	Mechanical Drawing	2	1	2	3
ME 2311	Electrical Machines	2	0	2	3
ME 2101	English Language-II	2	0	0	2
UOA 006	The Crimes of Baath Regime in Iraq	2	0	0	2
Total Hours and Credit Hours		17	5	10	22
		32			

Semester II (Spring Semester)

Course Code	Course Title	Weekly Hours			Credit Hours
		Theoretical	Tutorial	Practical	
ME 2202	Calculus-IV	3	1	0	3
ME 2305	Fluid Mechanics-II	2	1	2	3
ME 2306	Strength of Materials-II	2	1	2	3
ME 2307	Thermodynamics-II	2	1	2	3
ME 2308	Engineering Mechanics-II (Dynamics)	2	1	0	2
ME 2304	Engineering Metallurgy	2	1	2	3
ME 2310	Computer Programming	1	0	2	2
Total Hours and Credit Hours		14	6	10	19
		30			

Third Year (Junior)

Semester I (Fall Semester)

Course Code	Course Title	Weekly Hours			Credit Hours
		Theoretical	Tutorial	Practical	
ME 3302	Heat Transfer-I	2	1	2	3
ME 3303	Theory of Machines-I	2	1	2	3
ME 3202	Engineering Numerical Methods	3	0	2	4
ME 3304	Internal Combustion Engines	2	1	0	2
ME 3201	Engineering Statistics	3	0	0	3
ME 3102	Ethics and Leadership Skills	2	0	0	2
ME 3101	English Language-III	2	0	0	2
Total Hours and Credit Hours		16	3	6	19
		25			

Semester II (Spring Semester)

Course Code	Course Title	Weekly Hours			Credit Hours
		Theoretical	Tutorial	Practical	
ME 3307	Heat Transfer-II	2	1	2	3
ME 3308	Theory of Machines-II	2	1	2	3
ME 3301	Engineering Analysis	4	0	0	4
ME 3309	Gas Dynamics	2	1	0	2
ME 3310	Industrial Engineering and Economic Analysis	2	1	0	2
ME 3305	Manufacturing Processes	2	1	0	2
ME 3306	Research Methodology	1	0	0	1
Total Hours and Credit Hours		15	5	4	17
		24			

Fourth Year (Senior)

Semester I (Fall Semester)

Course Code	Course Title	Weekly Hours			Credit Hours
		Theoretical	Tutorial	Practical	
ME 4301	Design of Machine Elements-I	3	1	0	3
ME 4302	Air Conditioning	2	1	2	3
ME 4304	Mechanical Vibrations	2	1	2	3
ME 4303	Power Plants	3	0	0	3
ME 4308	Engineering Materials	2	1	0	2
ME 4303E	Finite Element Method	2	1	0	2
ME 4305	Final Year Project-I	2	1	0	2
Total Hours and Credit Hours		16	6	4	18
		26			

Semester II (Spring Semester)

Course Code	Course Title	Weekly Hours			Credit Hours
		Theoretical	Tutorial	Practical	
ME 4306	Design of Machine Elements-II	3	1	0	3
ME 4307	Refrigeration	2	1	2	3
ME 4309	Control Systems	2	2	2	3
ME 4304E	Computational Fluid Dynamics	1	1	2	2
ME 4302E	Renewable Energy	2	1	0	2
ME 4101	English Language-IV	2	0	0	2
ME 4310	Final Year Project-II	2	1	0	2
Total Hours and Credit Hours		14	6	6	17
		26			

ME Program Outcome Curriculum Map According to NGO's Criterion

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

Second Year (Sophomore) – First Semester (Fall Semester)							
Course Title	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				
Mechanical Drawing	X					X	X
Electrical Machines	X		X				
English Language II				X			X
The Crimes of Baath Regime in Iraq					X		
Second Year (Sophomore) – Second Semester (Spring Semester)							
Course Title	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 Mechanics II (Dynamics)	X						
Engineering of Metallurgy	X		X				
Computer Programming	X					X	X

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

Fourth Year (Senior)– First Semester (Fall Semester)							
Course Title	**i**	**ii**	**iii**	**iv**	**v**	**vi**	**vii**
Design of Machine Elements I	X	X			X		X
Air Conditioning	X	X	X		X		X
Power Plants	X	X					X
Mechanical Vibrations	X	X	X				X
Engineering Materials	X	X					X
Finite Element Method	X	X					X
Final Year Project I	X	X	X	X	X	X	X
Fourth Year (Senior)– Second Semester (Spring Semester)							
Course Title	**i**	**ii**	**iii**	**iv**	**v**	**vi**	**vii**
Design of Machine Elements II	X	X			X		X
Refrigeration	X	X	X		X		X
Control Systems	X	X	X				X
Renewable Energy	X	X					X
Computational Fluid Dynamics	X	X				X	X
English Language IV				X			X
Final Year Project II	X	X	X	X	X	X	X

Fourth Year Elective Courses							
Renewable Energy	X	X	X				X
Computational Fluid Dynamics	X	X					X
Fracture Mechanics	X	X					
Mechanics of Composite Materials	X	X					
Computer Applications	X	X					
Finite Element Method	X	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
GOs (ICAEE)	i	ii	iv	v	vii	iii	vi

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

Second Year (Sophomore) – First Semester (Fall Semester)							
Course Title/ 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	
Mechanical Drawing	X				X		X
Electrical Machines	X					X	
English Language II			X		X		
The Crimes of Baath Regime in Iraq				X			
Second Year (Sophomore) – Second Semester (Spring Semester)							
Course Title	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 Mechanics II (Dynamics)	X						
Engineering of Metallurgy	X					X	
Computer Programming	X				X		X

Third Year (Junior)– First Semester (Fall Semester)							
Course Title/ SOs (ABET)	1	2	3	4	5	6	7
Heat Transfer I	X	X			X	X	
Theory of Machines I	X	X			X	X	
Engineering Numerical Methods	X	X			X		X
Internal Combustion Engines	X	X			X		
Engineering Statistics	X	X		X			
Ethics and Leadership Skills			X	X	X		
English Language III			X		X		
Third Year (Junior)– Second Semester (Spring Semester)							
Course Title	1	2	3	4	5	6	7
Heat transfer II	X	X			X	X	
Theory of Machines II	X	X			X	X	
Engineering Analysis	X	X			X		
Manufacturing Processes	X	X			X		
Gas Dynamics	X	X			X		
Industrial Engineering and Economic analysis	X	X			X		
Research Methodology			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	X		X	X		
Air Conditioning	X	X		X	X	X	
Power Plants	X	X			X		
Mechanical Vibrations	X	X			X	X	
Engineering Materials	X	X			X		
Finite Element Method	X	X			X		
Final Year Project I	X	X	X	X	X	X	X
Fourth Year (Senior)– Second Semester (Spring Semester)							
Course Title	1	2	3	4	5	6	7
Design of Machine Elements II	X	X		X	X		
Refrigeration	X	X		X	X	X	
Control Systems	X	X			X	X	
Renewable Energy	X	X			X		
Computational Fluid Dynamics	X	X			X		X
English Language IV			X		X		
Final Year Project II	X	X	X	X	X	X	X

Program Outcome Curriculum Map According to SLO's Program

Program SLO's	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							
Engineering Mechanics I (Static)	x	x							
Principles of Manufacturing Processes	x	x	x	x					
Computer Science I	x	x		x	x		x		
Physics	x	x	x	x					
Arabic Language						x			
Human Rights and Democracy								x	x
First Year (Freshman) – Second Semester (Spring Semester)									
Calculus II	x	x							
Engineering Mechanics II (Dynamics)	x	x							
Engineering Drawing	x	x		x	x		x		
Chemistry	x	x	x	x					
Fundamentals of Electrical Engineering	x	x	x	x					
English Language I					x	x	x		
Computer Programming	x	x		x	x		x		

Second Year – First Semester (Fall Semester)									
Calculus III	x	x							
Fluid Mechanics I	x	x	x	x					
Strength of Materials I	x	x	x	x					
Thermodynamics I	x	x	x	x					
Mechanical Drawing	x	x		x	x		x		
Electrical Machines	x	x	x	x					
English Language II					x	x	x		
The Crimes of Baath Regime in Iraq								x	x
Second Year (Sophomore) – Second Semester (Spring Semester)									
Calculus IV	x	x							
Fluid Mechanics II	x	x	x	x		x			
Strength of Materials II	x	x	x	x		x			
Thermodynamics II	x	x	x	x		x			
Engineering Mechanics II (Dynamics)	x	x							
Engineering of Metallurgy	x	x	x	x		x			
Computer Programming	x	x		x	x		x		

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

Fourth Year – First Semester (Fall Semester)									
Design of Machine Elements I	x	x	x		x		x	x	x
Air Conditioning	x	x	x	x	x		x	x	x
Power Plants	x	x	x		x		x		x
Mechanical Vibrations	x	x	x	x	x		x		x
Engineering Materials	x	x	x		x		x		x
Finite Element Method	x	x	x		x		x		x
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	x	x
Refrigeration	x	x	x	x	x	x	x	x	01
Control Systems	x	x	x	x	x	x	x		x
Renewable Energy	x	x	x		x		x		x
Computational Fluid Dynamics	x	x	x		x		x		x
English Language IV					x		x		
Final Year Project II	x	x	x	x	x	x	x	x	x

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

University Requirements Courses

UOA 003 - English Language I (2-2-0-0)

Semester Offered
Spring semester
Prerequisites:
None

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:

- Tenses
- Using a bilingual dictionary
- Present tenses
- Collection: daily life
- Past tenses
- Time expressions
- Much/ many-
- a few, a little, a lot of
- Shopping
- Verb patterns-1
- Hot verbs
- What ……. Like?
- Synonyms and antonyms
- Present perfect
- Adverbs word pairs
- Have (go) to
- Words that go together
- Time clauses
- Hot verbs
- Verb patterns-2
- -ed/ -ing adjectives
- Passives
- Second conditional
- Phrasal verbs
- Present perfect continuous
- word formation
- Questions
- Social expressions-1
- Have/ have got
- Making conversation
- Word formation
- Personal information
- some/ any
- Articles
- Prices
- Future forms
- How do you feel?
- Comparatives and superlatives
- Directions
- For, since
- Short answers
- Should/ must
- At the doctor's
- If
- In the hotel
- Manage to, used to
- Exclamations
- Verbs and nouns that go together
- Might
- Social expressions-2
- Adverbs
- writing letters

Program and Course Outcomes:
By the end of successful completion of this course, the student will be able to:

1. Develop academic writing
2. Apply reading skills
3. Expand academic vocabulary through reading

4. Speak through group discussions and debates

Recommended Textbook(s):
John & Liz Soars, "New Headway Plus- Pre-Intermediate Student's Book", 10th ed 2012

UOA 005 - Human Rights and Democracy (2-2-0-0)

Semester Offered
Fall semester
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, The right of a Muslim to his Muslim brother, Parental rights, Right neighbour, The right of women, Human rights in the heavenly religions, Religious tolerance in Islam.

Course Topics:
- The Universal Declaration of Human Rights and other countries speak of human rights over the individual, society and the state.
- Sections of human rights in law and Sharia, statement of the rights of God Almighty and guarantees of human rights.
- The right to equality before the law and the right to equality and justice among individuals.
- Clauses of preserving the freedoms contained in the Universal Declaration of Human Rights, and the impact of the study.
- Freedoms related to the material rights of an individual, including personal freedom.
- Freedom of movement, residence and ownership.
- Statement of the sanctity of the home and the right of the individual to move.

Course Learning Outcomes:
Upon the successful completion of this course, students will be able to:
1. 1 Explain the concept of "human rights and democracy"
2. The status of human rights and freedoms in Islam
3. Define and describe the relationship between human rights and democracy

Recommended Textbook(s)
Human rights and freedoms. Prof. Dr. Mustafa Al-Zalmi.

UOA 001 - Arabic Language (2-2-0-0)

Semester Offered
Fall semester
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:
- Arabic grammar
- Arabic grammar, Arabic grammar, its importance and place in the language.
- Arabic grammar, Hamza al-Wasl sites and parts.
- Dictionaries of the Arabic language, and ways to reveal the meanings of words in dictionaries
- The rules of number and number, the rule of distinguishing the number and its formulation, the definition of the number and how to read it
- Arabic literature / the most prominent features and characteristics of Arabic literature.
- Arabic literature / Historical eras of Arabic literature.
- Arabic literature / The novel and its elements.
- Rhetoric/Truth and metaphor.
- Rhetoric/The arts of rhetoric
- Rhetoric/Poetry / Muallaqat poets and some contemporary poets.

Course Learning Outcomes:
1. Develop academic essay writing proficiency
2. Apply reading skills
3. Expand academic vocabulary through reading
4. Improve critical thinking skills
5. Developing the student's intellectual property in the field of the Arabic language, to acquire verbal and actual ability and skill.

Recommended Textbook(s):
By Topics

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

Semester Offered
Spring semester
Prerequisites:
UNV 003 - 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:
- Tenses
- Vocabulary (Jobs)
- Question forms
- Writing (informal letter)

- Present simple
- Present continuous
- Past simple
- Past continuous
- Verb patterns
- Would like and like
- What … like?
- Comparative and superlatives
- Present perfect
- Tense revision
- have to & got to
- have to & should & must
- Present simple or will
- Conditional clauses
- Verb patterns
- Active and passive
- Second conditional
- Might
- Have/have to
- Writing (Linking words +Describing a person)
- Have + noun
- Writing (a story 1)
- Will and going to
- Writing (postcard)
- Vocabulary (adjective formation)
- Writing (relative closes)
- Vocabulary (men and women)
- Writing (a biography)
- Vocabulary (job description)
- Writing (formal letter)
- Time clauses
- Writing (discussing ideas)
- Infinitives
- Writing (email)
- Vocabulary (phrasal verbs)
- 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)

Semester Offered
Fall semester
Prerequisites:
ME 2101 - English Language-II

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)

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 Learning Outcomes:

1. Develop academic writing
2. Apply reading skills

3. Expand academic vocabulary through reading
4. 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 - Ethics and Leadership Skills (2-2-0-0)

Semester Offered
Spring semester
Prerequisites:
None

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 Description
This course is designed for engineering students who are interested in advancing into Ethics 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 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)

Semester Offered
Spring semester
Prerequisites:
ME 3101- English Language-III

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 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 Learning Outcomes:

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

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

UOA 007 - Computer science I (2-1-0-2)

Semester Offered

Fall semester

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:

- Computer Components
- Software
- Operation system
- Introduction to MS-Word
- Introduction to MS-Power Point
- Introduction to MS-Excel
- Introduction to MS-Access

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 document. 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.
   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

UOA 006 - The Crimes of Baath Regime in Iraq (2-2-0-0)

- **المفردات الدراسية لمادة جرائم حزب البعث في العراق**

1	المقدمة	مقدمة عامة عن المنهج
2	الفصل الاول	جرائم نظام البعث وفق قانون المحكمة الجنائية العراقية العليا عام 2005 م
3	الفصل الثاني	الجرائم النفسية والاجتماعية وأثارها، وأبرز انتهاكات النظام البعثي في العراق
4	الفصل الثالث	الجرائم البيئية لنظام البعث في العراق
5	الفصل الرابع	جرائم المقابر الجماعية

- **الخطة الدراسية لمادة جرائم حزب البعث**
  - مقدمة عامة عن المنهج
  - جرائم نظام البعث وفق توثيق قانون المحكمة الجنائية العراقية العليا عام 2005
  - الجرائم النفسية والاجتماعية وأثارها، وأبرز انتهاكات النظام البعثي في العراق.
  - الجرائم الاجتماعية
  - انتهاكات القوانين العراقية.
  - صور انتهاكات حقوق الإنسان وجرائم السلطة -1 .
  - صور انتهاكات حقوق الإنسان وجرائم السلطة -2
  - الجرائم البيئية لنظام البعث في العراق .
  - تدمير المدن والقرى (سياسة الأرض المحروقة)
  - تجفيف الأهوار
  - جرائم المقابر الجماعية
  - التصنيف الزمني لمقابر الإبادة الجماعيةّ في العراق للمدة 1963 م – 2003 م.
  - التصنيف الزمني لمقابر الإبادة الجماعيةّ في العراق للمدة 1963 م – 2003 م.

COLLEGE REQUIREMENT COURSES

ENG 003– Calculus-I (3-3-1-0)

Semester Offered
Fall semester
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:
- Functions
- Limits
- Differentiation rules
- The Chain Rule, Implicit Differentiation
- Applications of differentiation
- Applications of differentiation
- Exponential and logarithmic functions.
- Trigonometric functions and their derivatives
- Hyperbolic functions and their derivatives
- Advanced Applications of differentiation
- Derivative and anti- derivative functions

Course Learning Outcomes:
By the end of successful completion of this course, the student will be able to:
1. To calculate Tangent line and slope problems.
2. Apply Drawing of functions.
3. Estimate Limit and continuity of functions.
4. To find 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.

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.

ENG 001– Physics (4-3-0-2)

Semester Offered
Fall semester
Prerequisites:
Non

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:

- Physics and measurement: Standards of length, mass and time, dimensional analysis.
- Physics and measurement: Standards of length, mass and time, dimensional analysis.
- Motion in one dimension: displacement, velocity, acceleration, motion diagrams.
- Motion in one dimension: displacement, velocity, acceleration, motion diagrams.
- Vectors: coordinate systems, vector and scalar quantities, some properties of vectors, adding vectors, subtracting vectors, multiplying a vector by a scalar
- Vectors: coordinate systems, vector and scalar quantities, some properties of vectors, adding vectors, subtracting vectors, multiplying a vector by a scalar
- Motion in two dimensions: the position, velocity and acceleration vectors.

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

- Measurements and Data Analysis
- Verification of Ohm's Law
- Verification of Ohm's Law
- Temperature Dependence of Electrical Resistance
- The Relationship between the Fusing Current of a conducting wire and its diameter
- Electrical conduction through semiconductor
- Determination of Dielectric Constant

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. Analyses 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 analyses 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

ENG 002– Chemistry (4-3-0-2)

Semester Offered
Spring semester
Prerequisites:
Non

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:
- Measurements in chemistry
- Problem Solving in Chemistry - Dimensional Analysis
- Atoms, Molecules and Ions
- Mass Relationships in Chemical Reactions
- Reactions in Aqueous Solutions

- Gasses and Thermochemistry
- Quantum Theory and the Electronic Structure of Atoms

Lab. Section

- Lab 1: Determine the concentration of the sodium hydroxide (NaOH) solution by titrating it with a standard solution of hydrochloric acid (HCl)
- Lab 2: Determine the concentration of the acetic acid by titrating it with a standard solution of sodium hydroxide
- Lab 3: Determine the concentration of the hydrochloric acid by titrating it with a standard solution of sodium carbonate (Na2CO3)
- Lab 4: Determine the concentration of sodium carbonate (Na2CO3) and sodium bicarbonate (NaHCO3) in a mixture, titrating it with a standard hydrochloric acid solution.
- Lab 5: Measurement of turbidity in a water sample with discussion
- Lab 6: Density Measurements
- Lab 7: Viscosity Measurements

Course Learning Outcomes:

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

1. Define the structure of atoms in terms of the nucleus with protons, neutrons, & electrons.
2. Write and balance chemical equations, name inorganic compounds and ions and describe the properties of the main group elements.
3. C` arry out chemical calculations, including mass relations in chemical reactions, limiting reagent & reaction yield calculations, and calculations of 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 π bonds, and delocalized molecular orbitals.

Recommended Textbook(s):

Introductory Chemistry Essentials, Nivaldo J. Tro

ENG 006– Engineering Mechanics I (Statics) (3-3-1-0)

Semester Offered

Fall semester

Prerequisites

Non

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:

- Force system
- Equilibrium of particles
- Force System Resultants
- Equilibrium of a Rigid Body
- Trusses: method of joint and sections
- Frames
- Centroid
- Moment of inertia
- frictions

Course Objectives

The Objectives of this course are to enable students to:

1. To understand the different types of Force systems and recognize the best way to deal with each one.
2. To determine the resultant of multi-Forces of different types of forces and moments.
3. To study and analyze the Equilibrium of force system of particles
4. To study and analyze the Equilibrium of a Rigid Body
5. To understand and solve the forces within Truss members using two types of solutions: method of joint and sections
6. To determine the forces within Frames
7. To locate the centroid and mass of gravity of different shapes.
8. To determine the Moment of inertia of many geometries.

To deal with the friction force between two or more bodies in contact.

Course Learning Outcomes:

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

1. Determine the resultant of coplanar forces and non-concurrent force systems for particles and rigid bodies in two or three dimensions.
2. Use Free Body Diagrams to solve static problems to understand all types of forces that act on bodies.
3. Explain the principles of static equilibrium.
4. Solve problems relating to the forces in truss members
5. Analyze the forces acting on the members of frames and machines.
6. Determine the location of the center of gravity and centroid for a system of discrete particles and a body of arbitrary shapes.
7. Develop a method for determining the moment of inertia for an area.
8. Solve problems relating to dry friction, including inclined planes.
9. Determine the support reactions on a structure.
10. Apply virtual work to solve equilibrium problems.
11.

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.

ENG 005- Fundamentals of Electrical Engineering (3- 2- 1- 2)

Semester Offered
Spring semester
Prerequisites:
Non

Course Definition
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 Fundamental of electrical engineering, which is a continuation of the survey of principles of classical electrical engineering presented in course. 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 Topics:
- Introduction - Difference between Circuit Theory and Field Theory
- Basics of Network Elements
- Charge, Current and Voltage
- Power and Energy
- Resistance and Resistivity and Ohm's Law
- Kirchhoff's Laws
- Series Resistors and Voltage Division
- Parallel Resistors and Current Division
- Wye-Delta Transformations
- Circuit Analysis - Nodal and Mesh
- Linearity and Superposition
- Source Transformations
- Thévenin and Norton Equivalents
- Maximum Power Transfer

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. Recognize how electricity works in electrical circuits.
2. List the various terms associated with electrical circuits.
3. Summarize what is meant by a basic electric circuit.

4. Discuss the reaction and involvement of atoms in electric circuits.
5. Describe electrical power, charge, and current.
6. Define Ohm's law.
7. Identify the basic circuit elements and their applications.
8. Discuss the operations of sinusoid and phasors in an electric circuit.
9. Discuss the various properties of resistors, capacitors, and inductors.
10. Explain the two Kirchoff's laws used in circuit analysis.
11. Identify the capacitor and inductor phasor relationship with respect to voltage and current

Laboratory

- Lab 1: Equipment Familiarization
- Lab 2: Ohm's Law
- Lab 3: Kirchhoff's Laws
- Lab 4: Series Resistors and Voltage Division
- Lab 5: Parallel Resistors and Current Division

Recommended Textbook(s):

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

ENG 004– Calculus-II (3-3-1-0)

Semester Offered
Spring semester
Prerequisites:
ENG 003 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. The mean topics of the course are: Transcendental functions, Techniques of integration, Sequences and Infinite series. Parametric equations and polar coordinates.

Course Topics:

- Integral
- Integration Techniques -Integration by Parts.
- Integration Techniques- Trigonometric Integrals.
- Integration Techniques- Partial Fractions
- Applications of Integrals-Infinite Integral, Areas
- Applications of Integrals- Arc Length, Surface area
- Applications of Integrals- Volumes (Disk, Washer, Shell)
- Polar Coordinates -Common Polar Coordinate Graphs
- Polar Coordinates - Tangents with Polar Coordinates, Curves defined by parametric equations.
- 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 indefinite and definite integrals.
2. Use definite integrals to solve application problems.
3. Use various integration techniques to evaluate integrals.
4. Evaluate integrals of rational functions by partial fractions.
5. Define the basic concepts and techniques of integration of polynomial, rational, transcendental and trigonometric functions.
6. Compute an anti-derivative using integration by parts.
7. Describe a point on a graph using polar coordinates.
8. Plot a point given its polar coordinates.
9. Convert between polar and Cartesian coordinates.
10. Find the distance between points in polar form.

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.

ENG 007– Engineering Drawing (3-2-2-2)

Semester Offered

Spring semester

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 to engineering drawing
- Using drawing tools
- Applied geometry
- Orthographic projection
- Orthographic writing I
- Orthographic writing II
- Pictorial sketching
- Orthographic reading

- Dimensioning
- Section views
- Introduction to Auto CAD
- Different Software for CAD
- Practice Exercises on Auto CAD Software
- Drawing Plan of a building in Auto CAD
- Drawing Section and Elevation of a building in Auto CAD
- Detailing of engines components

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:
1. Recognize the value of engineering graphics as a language of communication.
2. Infer the nature of engineering graphics, the relationships between 2D and 3D environments.
3. Comprehend and deduce orthographic projections of an object.
4. Visualize wide variety of objects and drawing the missing views.
5. Comprehend and deduce section views.
6. 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)

Semester Offered
Fall semester
Prerequisites:
ENG 104 – 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:
Complex Numbers
- ✓ Introduction
- ✓ Algebra of complex numbers
- ✓ Point representation of complex numbers

- ✓ Complex conjugate

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

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

Partial Differentiation

- ✓ Definition
- ✓ 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

Multiple Integrals

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

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

Ordinary differential Equations

- ✓ Classify differential equations by order, linearity, and homogeneity

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

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)

Semester Offered
Spring semester
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. Modelling 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:
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

Simultaneous Linear Differential Equations

- ✓ Elimination of dependent variables by differentiation
- ✓ Elimination of dependent variables using operator equation
- ✓ Solution by Cramer rule

Fourier series

- ✓ Periodic functions
- ✓ Trigonometric series
- ✓ Bounds of a Function
- ✓ Continuity of a Function
- ✓ Euler Coefficients
- ✓ Even and Odd Functions
- ✓ Half Range Expansion
- ✓ Applications

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

Special Functions

- ✓ Gama Function
- ✓ Beta Function

Sequences and Series

- ✓ Definition
- ✓ The General Term Test
- ✓ The Integral Test
- ✓ The Comparison Test
- ✓ The Limit Comparison Test
- ✓ The Ratio Test
- ✓ The Root Test
- ✓ Alternating Series
- ✓ Power Series
- ✓ Interval of Convergence
- ✓ Taylor Series
- ✓ Maclaurin Series
- ✓ Applications

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.

Course Learning Outcomes

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

1. Calculate the Infinite Fourier transform, Fourier Sine and Cosine transform of elementary functions from the definition.
2. Calculate the Finite Fourier cosine and sine transform and apply it in solving boundary value problems.
3. Find the Laplace transform of a function from the definition of a Laplace transform.
4. Use Laplace transforms to determine general or complete solutions to linear ODEs.
5. Find the Maclaurin and Taylor series.

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)

Semester Offered

Fall semester

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 estimates
   2.2. An interval estimates
   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 t-Test
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 case 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 (4-3-0-2)

Semester Offered

Fall semester

Prerequisites:

ME 2202 Calculus-IV

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 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 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)

MEC 001– Principles of Manufacturing Process (3-2-2-2)

Semester Offered
Fall semester
Prerequisites
None

Course Definition
This course is designed to meet the needs of student majoring in Engineering. 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 Topics

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

Weekly Lab. Syllabus

- Casting process, sand casting mould.
- Welding process.
- Turning process.
- Milling process.
- Carpenter workshop
- Grinding 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. To understand the principles of major manufacturing processes.
2. To recognize the standard processes used to produce products.
3. To know the optimal process to produce products.

Course Learning Outcomes:

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

1. Understand the principle of manufacturing engineering.
2. Obtain important information about the iron ores and how can obtain the different types of iron and steel.
3. Classify materials and their improvement properties.
4. 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

Second Year (Sophomore Level)

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

Semester Offered (Fall – Spring)
Fall Semester
Prerequisites
Non

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 Modelling
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, analyse 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. Analyse and comprehend the mass, Bernoulli, momentum analysis of flow systems and energy equations.
4. Review the concepts of dimensions and units, analyse 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

ENG 006 Engineering Mechanics I (Static)

Course Definition

Strength of materials, also called mechanics of materials, is a subject which deals with the behaviour 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 behaviour 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
Non

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 Zeros 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

Spring semester

Prerequisites

MEC 001 Principles of Manufacturing Process

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 monitoring 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
Spring 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 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:

- Turbulent flow through pipes
- Major and Minor Losses of flow in piping system
- Piping Networks and Pump Selection
- Flow Rate and Velocity Measurements
- Flow over Bodies: Drag and lift
- 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

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

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

Lab Experiments:

- Flow through Venturi Meter.
- Major losses (frictional energy losses) in pipes.

- 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
Spring 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 behaviour 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
- Deflection of determinate beams
- Deflection of indeterminate beams
- Thin cylinders
- Thick cylinders
- combined stress
- Theories of failure

Course Description
Topics to be chosen from elastic and elastic-plastic behaviour, 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

Spring 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

- The Second Law of Thermodynamics
- Heat Engine and Its Types
- Refrigerators & Heat Pumps
- Entropy Of Single Phase (Ideal Gas)
- Entropy Of Tow Phase (Vapor)
- Heat Engine Cycles
- Carnot & Otto Cycles
- Brayton & Diesel Cycles
- Dual Cycle and Mean Effective Pressure

- Steam Cycles (Carnot & Rankine Cycles)
- Superheated & Reheated Rankine Cycles
- Refrigeration System
- Carnot Cycle
- 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".

MEC 002 & ME 2308 – Engineering Mechanics II (Dynamics) (2-2-1-0)

Semester Offered
spring semester
Prerequisite
ENG 006 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
- Rectilinear Kinematics: Continuous Motion
- Kinetics of a Particle: Force and Acceleration
- Kinetics of a Particle: Work and Energy
- Principle of Work and Energy
- Principle of Work and Energy for a System of Particles
- Power and Efficiency
- Conservation of Energy
- Principle of Linear Impulse and Momentum
- Impact
- Angular Momentum
- 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

Recommended 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
ENG 007 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
- Sectional views
- Nuts, bolts, screws
- Keys and keyways
- Welding and welding symbols
- Tolerancing dimensions and fits
- Gears
- 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.

MEC 003 & ME 2310 - Computer Programming (2-1-0-2)

Semester Offered

Spring semester

Prerequisites:

Non

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

- Programming structures, variables/data types, read /write/print statements,
- IF Statements.
- Do Loops.
- File Input and output and formatting
- Arrays and Matrices
- Subroutines and Functions
- 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 program from specifications and document that 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 Textbooks

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

ENG 005 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

- DC machines construction, Principle of operation of DC generators
- Types of DC generators, Losses and efficiency of DC generators
- Parallel operation of DC generators, Principle of DC motors
- Types of DC motors, DC motors losses, efficiency
- Speed control of DC motors
- Transformer construction
- principle of operation of transformer
- Types of transformers ordinary, all-day, and auto, Losses and efficiencies
- 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 (4-4-0-0)

Semester Offered
Spring 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
- Modelling with Higher Order Linear Differential Equations.
- Applications of Ordinary Differential Equations.
- Fourier series
- Partial Differential Equations.
- Functions of complex variables
- 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 Textbooks:
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

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
- Basic of heat transfer
- Mechanism of heat transfer
- Forms of heat transfer
- Multi- and one-dimensional conduction heat transfer
- Boundary and initial conditions, thermal resistance
- Heat sources systems (heat generation)
- Heat transfer from fins
- Kinds of fins, fin efficiency and fin effectiveness
- Steady-state conduction multi-dimensions (nodal solution)
- Numerical method for analysis steady-state heat transfer
- Unsteady-state conduction (transient)
- Lumped heat capacity system
- Transient numerical method
- Transient heat conduction in plane walls, cylinders, and spheres
- Transient heat conduction in plane walls, cylinders, and spheres Thermal Radiation and the View Factor.
- Radiation Heat Transfer: Diffuse, Gray Surfaces, Radiosity.
- 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. Understand the conduction and radiation heat Transfer Mechanisms.
2. Recognize Heat Transfer from Finned Surfaces.
3. Derive the formula of steady-state conduction heat transfer in solids using numerical methods.
4. Solve unsteady-state conduction heat transfer in small and large bodies and also by using numerical methods.
5. Illustrate Radiation heat transfer from different coloured bodies.
6. 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)

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

- Velocity and acceleration diagrams.
- Mechanisms with lower pairs (Hook's joint, Steering gear).
- Gyroscopic couple.
- Turning moment diagrams and flywheel.
- 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. 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-(2-2-1-0)

Semester Offered
Fall semester
Prerequisites
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
- Engine Types and Their Operation, Engine Design and Operating Parameters.
- Air standard Cycles.
- Fuel-Air Cycles, and Actual Cycles.
- Thermochemistry of Fuel-Air Mixtures.
- 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
Spring semester
Prerequisites
ME 2304 - Engineering Metallurgy

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

Course Topics

- Tensile properties
- Compression properties
- Shear properties
- Hardness
- Effect of Temperature on Properties
- Fluid Properties
- Bulk deformation
- Rolling
- Forging
- Extrusion
- 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

Spring 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

- Project proposal.
- Basic of research methodology
- Review of previous works.
- Nature of the projects
- Results analysis
- How to write your project.
- 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

- Physical Mechanism of Convection
- Classification of Fluid Flows
- Thermal Boundary Layer
- Hydraulic boundary layer
- External Forced Convection
- Parallel Flow over Flat Plates
- Flow across Cylinders and Spheres
- Flow across Tube Banks
- Internal Forced Convection
- Laminar Flow in Tubes
- The Entrance Region
- Turbulent Flow in Tubes
- Natural Convection from Finned Surfaces
- Natural Convection inside Enclosures
- 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. Understand the free and forced convection heat Transfer Mechanisms.
2. Recognize the internal and external convection heat transfer.
3. Distinguish the laminar and turbulent convection heat transfer of internal and external flows.
4. Illustrate convection heat transfer from fins.
5. 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 Textbooks:
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
Spring 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
- Balancing of rotating masses

- Spur Gearing
- Gear trains
- Belt drive
- 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. 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. 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 (2-2-1-0)

Semester Offered
spring 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
- Compressible fluid flow
- One Dimensional Isentropic flow
- Normal shock Waves
- Oblique shock Waves
- Flow in constant area duct with friction (Fanno flow)
- 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 Textbooks:
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
ME 2202 calculus IV

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
- Process of organization design
- Product layout flow
- Systematic layout planning
- Flow process charts
- Bill of material
- Material handling
- Human engineering
- Quality control and Inspection
- Control chart for attributes
- 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 layouts. 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
- Fundamentals of mechanical engineering design
- Failures Resulting from Static Loading
- Fatigue Failure Resulting from Variable Loading
- Shafts and Shaft Components
- Screws, Fasteners, and the Design of No-permanent Joints
- 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 No permanent 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
- Introduction to air conditioning
- Moist air properties
- Psychrometric chart and psychrometry processes
- Thermal comfort
- Indoor and outdoor design conditions
- Heating load calculation
- Cooling load calculation
- Air conditioning systems
- 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.
8.

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 (3-3-0-0)

Semester Offered (Fall– Spring)
Fall semester
Prerequisites
ME 2307 Thermodynamics-II

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

- Introduction of thermodynamic cycles used in power plants
- Advanced Rankine Cycle (Reheating, Regenerative)
- Steam generators, steam condensers
- Steam turbines
- Introduction to gas turbine power plants
- Modification of the basic cycle (intercooling & reheating)
- Modification of the basic cycle (Regeneration)
- Introduction to Diesel Power Plant
- Cooling, lubricating, supercharging of Diesel Power Plant
- Diesel engine performance and operation
- Economics of Power Plants
- Cost analysis of a power plant
- Nuclear power plants
- 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

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

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. Identifying the variable plant factors 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 3308 Theory of Machine II

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 provides 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
- Mechanical Springs
- Rolling-Contact Bearings
- Lubrication and Journal Bearings
- Gears-General.
- Spur, Helical, Bevel, and Worm Gears
- 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

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

- Introduction and review of basic principles.
- Vapour compression cycle and heat pumps.
- Refrigerants.
- Vapour absorption cycle.
- Air refrigeration systems.
- Thermoelectric refrigeration.
- Vortex tube refrigeration.
- 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. Electrolux 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
ME 2304 Engineering Metallurgy

Course Definition
In this subject the properties of engineering materials are 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
- Material Properties
- Mechanical Properties
- Temperature Effect
- Physical Properties
- Engineering Materials (Ferrous Metal)
- Engineering Materials (Nonferrous Metal)
- Engineering Materials (Non-metallic)
- Designation the Engineering Materials
- Selection of Materials

Course Description
Properties of materials (Mechanical tensile properties, fatigue cyclic stresses, stress life behaviour, 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 behaviour. semi crystalline, plastic, fibres, ceramic structure and properties, silicate ceramics, glasses and glass ceramic, clay products, cements, advanced ceramics. Composites materials, fibre 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. know the developments of new materials.

Lab Experiments
None

Recommended Textbooks

1. J T. Black, R. A. Kohser and E. P. Degarmo, "Materials and processes in manufacturing ", 10th Edition, 2008.
2. Materials Science and Engineering an Introduction William D. Callister, Jr.
3. Foundations of Materials Science and Engineering, by William F. smith & Javad Hashemi
4. Ceramic Science for Materials Technologist by T.J Mc-Calm
5. Engineering with polymers by P.C. Powel

ME 4309 - Control Systems (3-2-2-2)

Semester Offered
Spring semester
Prerequisites:
ME 3308 – Theory of Machine II

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

- Introduction to automatic control system
- Representation of control components
- Representation of control systems:
  - Mass, spring damper system
  - Hydraulic system
  - Pneumatic system
  - Electrical system
  - Thermal system
- Steady-state operation
- Laplace transformer
- Transient and steady-state responses
- Steady-state errors in control systems
- Stability of control systems
- The rout locus method
- 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.

ME 4305 – Final Year Project I (2-2-1-0)

Semester Offered
Fall semester
Prerequisites
None

Course Definition
Final year project is a core course, which is a part of student training as a researcher in mechanical engineering department. The project is the final part of the work on the dissertation and presents its practical part. During the implementation of the project, undergraduates work out in laboratory conditions the results of scientific research obtained at the previous stages of work on the dissertation. The project is carried out in specialized laboratories in scientific

groups. Final project allows you to gain professional skills and experience in research activities. For successful development of Final project, the student must possess practical knowledge, skills, universal, professional and General professional competencies acquired as a result of mastering the previous blocks of the education program.

Material Covered:

- Prepare to final project, familiarization with the goals, objectives and content
- Reports and deadlines for their submission, preparation of a time table and contents of project. Workplace safety briefing. Preparing the workplace of the engineer-researcher.
- Development of the first part of the report - the results of an in-depth analytical review on the research topic.
- Identification of the main technical characteristics and metrics for analytical comparison of known solutions and the expected results of the final project.
- Development of requirements for the technical characteristics and composition of laboratory equipment for research.
- Assembling a laboratory demonstrator. Development of a methodology for conducting an experiment. Testing a laboratory setup. Preparation of a scientific article describing the laboratory facility.

Course Objectives

The objectives of the course are as follows:

1. The objective of the Final Year Project is to demonstrate a student's ability to apply the knowledge and skills gained throughout his/her studies to a specific area in any topic in the mechanical engineering department in a methodical and analytical manner.
2. Allow students to enhance their problem-solving and analytical skills.
3. Make students aware of real-life constraints and allow them to critically evaluate alternatives before selecting a final option.
4. Foster teamwork and effective collaboration skills.
5. Enhance students' technical writing and professional communication skills.
6. Developing the ability to critically analyse and evaluate current scientific achievements, generate new ideas when solving research and practical problems.
7. Defining the area of scientific research and analysing the state of the issue in the subject area under study; developing readiness and basic skills for self-formulation and solving problems that arise in the course of research activities and require in-depth professional knowledge.
8. Processing and analysis of the results of theoretical and experimental research, the formation of skills to use modern technologies for collecting information, processing and interpreting the obtained empirical data.

Module Learning Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
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.
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

4. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
5. Ability to comprehend professional and ethical responsibilities.
6. An ability to function as a team member and as well as a leader in the project group. The ability to present what has been done in a scientific and practical manner and to answer the examination committee's inquiries convincingly as one team.

ME 4310 – Final Year Project II (2-2-1-0)

Semester Offered
Spring semester
Prerequisites
None

Course Definition
Final year project is a core course, which is a part of student training as a researcher in mechanical engineering department. The project is the final part of the work on the dissertation and presents its practical part. During the implementation of the project, undergraduates work out in laboratory conditions the results of scientific research obtained at the previous stages of work on the dissertation. The project is carried out in specialized laboratories in scientific groups. Final project allows you to gain professional skills and experience in research activities. For successful development of Final project, the student must possess practical knowledge, skills, universal, professional and General professional competencies acquired as a result of mastering the previous blocks of the education program.

Material Covered:
- Experiments, accumulation and analysis of the results.
- Processing of the data obtained for the preparation of an analytical review.
- Development of the final chapter of the thesis. Preparation of the results of practical implementation for patenting. Registration of accompanying documents for transfer to the intellectual property agency
- Processing and interpretation of research results. Presentation and publication of the results in the form of theses, articles, presentation at the theoretical seminar of the profile Department.
- Scientific interpretation of the data obtained, their generalization, analysis of the research work done, and design of theoretical and empirical materials in the form of a report on final project.

Course Objectives
The objectives of the course are as follows:

1. The objective of the Final Year Project is to demonstrate a student's ability to apply the knowledge and skills gained throughout his/her studies to a specific area in any topic in the mechanical engineering department in a methodical and analytical manner.
2. Allow students to enhance their problem-solving and analytical skills.
3. Make students aware of real-life constraints and allow them to critically evaluate alternatives before selecting a final option.
4. Foster teamwork and effective collaboration skills.

5. Enhance students' technical writing and professional communication skills.
6. Developing the ability to critically analyse and evaluate current scientific achievements, generate new ideas when solving research and practical problems.
7. Defining the area of scientific research and analysing the state of the issue in the subject area under study; developing readiness and basic skills for self-formulation and solving problems that arise in the course of research activities and require in-depth professional knowledge.
8. Processing and analysis of the results of theoretical and experimental research, the formation of skills to use modern technologies for collecting information, processing and interpreting the obtained empirical data.

Module Learning Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
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.
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
4. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
5. Ability to comprehend professional and ethical responsibilities.
6. An ability to function as a team member and as well as a leader in the project group.
7. The ability to present what has been done in a scientific and practical manner and to answer the examination committee's inquiries convincingly as one team.

Fourth Year Elective Courses

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

Semester Offered
Fall semester
Prerequisites
ME 2202 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

- Interface and applications of Solidworks (a sample software)
- 3D drawing and dimensions
- Orthographic views and cutting
- Threads of screws
- Threads of nuts
- Gears drawing
- Boundary conditions, meshing and simulation
- Simulations (thermal systems applications)
- Simulations (materials applications)
- Simulations (design applications)
- Simulations (Fluid mechanics applications)
- 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

Spring semester

Prerequisites:

ME 3302 - Heat Transfer-I

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

Course Topics
- Introduction to Renewable Energy
- Introduction to Solar Energy
- Designing of Thermal Solar Collectors
- Designing of PV System
- Wind Energy
- Other Renewable Energy Resources (Hydroelectric, geothermal, Biomass, Tidal)
- 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 (2-2-1-0)

Semester Offered

Elective

Prerequisites

ME 2306 - Strength of materials-II

ME 3301 – Engineering Analysis

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

- Introduction
- Bar Element
- Beam Element
- Linear static analysis
- Two-Dimensional Analysis
- Finite element for two-dimensional problems
- Development of Truss Equations
- Development of Frame and Grid Equations
- Development of the Plane Stress and Plane Strain Stiffness Equations
- Isoperimetric Formulation
- Numerical Quadrature, Three-Dimensional Stress Analysis
- Finite Element Modelling and Solution Techniques
- Plate Elements
- Solid Elements for 3-D Elements
- 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 (CFD) (2-1-1-2)

Semester Offered
Fall semester
Prerequisites
ME 3202 - Engineering Numerical Methods
ME 3307 Heat Transfer II

Course Definition
Studying the basic concepts and applications of computational fluid dynamics to the analysis and design of fluid systems and components.

Course Topics
Mathematical Modelling
Boundary Conditions
Discretization Method: Finite Difference Methods
FDM First Order And Second Orders
Numerical Modeling and Simulation
Nonlinear Problems
Irregular Shapes

Course Description
The course is an introductory course to computational fluid dynamics for undergraduate students. The finite difference method will be used to solve different types of Partial Differential Equations that describe various fluid dynamics and heat transfer problems. The discretization, stability, and error analysis are elaborated. A commercial code ANSYS will be used to solve Navier-Stokes (NS) equations for incompressible flow.

Course Objectives
1. Analyze mathematically the governing equations for fluid flow and heat transfer.
2. Improve skills in computational fluid dynamics to address engineering problems.
3. Study applying finite difference method in solving different types of Partial Differential Equations (PDEs) that describe different fluid dynamics and heat transfer problems.
4. Practice using ANSYS FLUENT in design, meshing, and solving various CFD applications.

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

1. To understand basic concepts of computational methods.
2. To characterize the partial differential equations numerically by applying Tylor series techniques.
3. To apply various discretization methods for 1D and 2D problems.
4. To model and simulate numerically different practical fluid flow and heat transfer applications by Ansys.

Recommended Textbooks
1. Hoffmann, K. A. (1989): Computation fluid dynamics for engineers. A publication of engineering education systemTM, Austin, Texas 78713, USA.
2. Anderson, J. D. Jr. (1995): Computation fluid dynamics, the basic with applications, McGraw-Hill, New York.
3. Boss, T. K. (1997): Numerical fluid dynamics, Narosa Publishing House, New Delhi.
4. Computational Fluid Dynamics, An Introduction, John F. Wendt (Ed.), 2009.
5. Computational Fluid Mechanics and heat transfer, John C. Tannehill et al., 1997.

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
- Micromechanics
- 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: Fiber reinforced Composites Materials, Manufacturing, and Design, By: P.K. Mallick 3rd edition

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

Semester Offered

Elective

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:
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
- Aerodynamic forces and moments
- Center of pressure
- Streamlines
- Vorticity
- Circulation
- Stream function
- Potential flow
- Airfoil characteristics, vortex sheets
- Thin airfoil theory
- Flow fields around finite wings
- Prandtl's lifting-line theory
- Introduction to compressible flow
- Velocity potential equation
- 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)

Semester Offered
Elective
Prerequisites:
ME 3201 Engineering statistics

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, and robot localisation.
4- Ability to apply Artificial Intelligence techniques for problem solving.
5- Explain the limitations of current Artificial Intelligence techniques.

Recommended Textbook(s)
Russell, Norvig. Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.

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

Semester Offered
Fall semester
Prerequisites
MEC 001- Principles of Manufacturing Process.
ME 3201- Engineering Statistics.
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)

Semester Offered
Elective

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

Recommended Textbook(s):
-D.A. Jones, Principles and Prevention of Corrosion, 2nd edition, Prentice Hall, 1996.
-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
- Heat Exchangers Classifications
- Thermal Design Considerations
- Process (Thermal) Design Procedure
- Design Problems

- Process design of shell and tube exchanger for two-phase heat transfer
- Condenser
- Condenser design
- Condenser and Reboiler Design
- De-superheating and sub-cooling
- Reboilers
- Design of kettle reboiler
- 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.
6.

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 4312E - Electromechanics & Electronics (2-2-0-0)

Semester Offered (Fall– Spring)
Elective
Prerequisites
ENG 005- Fundamentals of Electrical Engineering.
ME 2311 Electrical 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

- Introduction to Electromechanical systems.
- Mechanical Engineering subsystems.
- Electrical and electronics controller.
- 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 photoelasticity. 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 behaviour of complex elements into appropriate sub- systems/elements and then analyses the behaviour 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)
Elective
Prerequisites
ME 3310 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.