بسم الله الرحمن الرحيم

جامعة الملك خالد

كلية الهندسة

قسم الهندسة الميكانيكية

جدول الخطة الدراسية

لبرنامج بكالوريوس العلوم في الهندسة الميكانيكية

اصدار 12

1445

جدول الخطة الدراسية

Distribution of courses over the different levels
Bashlor of Science in Mechanical Engineering
(Edition 12)

Course Code	Course Title	Weekly Distribution of Credit Hours				Prerequisites
		Lectures	Lab	Credit Hours	Contact Hour	
First Year - First Level						
011ENG-6	Intensive English Program-1	-	6	6	12	--
107 CHEM- 4	General Chemistry	3	1	4	5	--
119 MATH-3	Differentiation and Integration-1	3	-	3	3	--
111 ICl-2	The Entrance to the Islamic Culture	2	-	2	2	--
201ARAB-2	Language Skills	2	-	2	2	--
	Total Number of Hours	**10**	**7**	**17**	**24**	
First Year – Second Level						
012 ENG-6	Intensive English Program-2	-	6	6	12	011ENG-6
103 CMS-3	Computer Science	2	1	3	4	--
219 MATH-3	Differentiation and Integration-2	3	-	3	3	119 MATH-3
129 PHYS-4	Physics-1	3	1	4	5	--
112 IC1-2	Islamic Culture-2	2	-	2	2	--
	Total Number of Hours	**9**	**8**	**18**	**26**	
Second Year – Third Level						
111-GE-3	Engineering Drawing	-	3	3	6	--
211-ME-3	Material Science	2	1	3	4	129 PHYS-4 107 CHEM- 4
212-ME-2	Engineering Mechanics (statics)	2	-	2	2	--
211 GE-2	Learning skills	2	-	2	2	--
219 PHYS-4	Physics-2	3	1	4	5	129 HYS-4
229 MATH- 3	Differentiation and Integration-3	3	-	3	3	219 MATH-3
	Total Number of Hours	**12**	**5**	**17**	**22**	
Second Year – Fourth Level						
221-ME-3	Production Technology and Workshop	1	2	3	5	111-GE-3
222-ME-3	Thermodynamics-1	2	1	3	4	129 PHYS-4 119 MATH-3
223-ME-3	Strength of Materials & Testing	2	1	3	4	211-ME-3
221-GE-2	Creativity and Innovation	2	-	2	2	--
202 ARAB- 2	Arabic Writing	2	-	2	2	--
222-GE-2	Engineering Programming	1	1	2	3	103CMS-3
319 MATH- 3	Differential Equations	3	-	3	3	219 MATH-3
	Total Number of Hours	**13**	**5**	**18**	**23**	
Third Year – Fifth Level						
311-ME-3	Metal Cutting Processes	2	1	3	4	211-ME-3

						221-ME-3
312-ME-3	Mechanical Engineering Drawing	1	2	3	5	111-GE-3
313-ME-2	Engineering Mechanics (dynamics)	2	-	2	2	--
218 EE-3	Electric Engineering-1	2	1	3	4	129 PHYS-4 119 MATH-3
113 IC1-2	Islamic Culture-3	2	-	2	2	--
329 MATH- 3	Linear Algebra	3	-	3	3	--
301 NGL-2	Technical Reports Writing	2	-	2	2	012 ENG-6
	Total Number of Hours	**14**	**4**	**18**	**22**	
						Third Year – Sixth Level
321-ME-3	Theory of Machines	2	1	3	4	212-ME-2 313-ME-2
322-ME-3	Fluid Mechanics	2	1	3	4	222-ME-3
328-EE-3	Electric Engineering-2	2	1	3	4	218 EE-3
419 MATH-3	Numerical Methods	3	-	3	3	319 MATH- 3
329 STAT-2	Principles of Statistics and Probability	2	-	2	2	--
114 IC1-2	Islamic Culture-4	2	-	2	2	--
	Total Number of Hours	**13**	**3**	**16**	**19**	
						Summer Internship
400 ME-0	Summer Internship	0	0	0	0	Completion of 95 credit hours
						Fourth Year–Seventh Level
411-ME-3	Machine Elements Design-1	2	1	3	4	223-ME-3 312-ME-3
412-ME-3	Metal Forming Processes	2	1	3	4	211-ME-3 221-ME-3
413-ME-3	Heat Transfer	2	1	3	4	322-ME-3
414-ME-2	Measuring Devices	1	1	2	3	321-ME-3
411-GE-2	Professional Ethics and practice	2	-	2	2	--
xxx	Free course- 1	3	-	3	3	--
	Total Number of Hours	**12**	**4**	**16**	**20**	
						Fourth Year– Eighth Level
421-ME-3	Machine Design	2	1	3	4	411-ME-3
422-ME-3	Thermodynamics-2	2	1	3	4	222-ME-3
423-ME-3	Hydraulic Machines & Fluid Power Systems	2	1	3	4	322-ME-3
424-ME-3	System Dynamics & Mechanical Vibrations	2	1	3	4	321-ME-3 319 MATH- 3
311-INE-2	Engineering Economy	2	-	2	2	--
	Elective-1	2	-	2	2	--
	Total Number of Hours	**12**	**4**	**16**	**20**	
						Fifth Year–Ninth Level
573-ME-4	Senior Design Project	4	-	4	4	Completion of 125 credit hours
511-ME-3	Control Systems	2	1	3	4	424-ME-3
511-GE-2	Engineering Entrepreneurship	2	-	2	2	--
	Elective -2			3		--

	Elective -3			3		--
xxx	Free course-2	2	-	2	2	--
Total Number of Hours				**16**		
Fifth Year–Tenth Level						
411-INE-2	Engineering Managements	2	-	2	2	
	Elective-4			3		
	Elective-5			3		
Total Number of Hours				**8**		

Elective courses

Elective courses (2), (3), (4) and (5) are selected according to the following:

1 - **Students interested in power engineering path**: choose the courses of power engineering path only from the list of elective courses

2 - **Students interested in engineering design and production path**: Choose the courses of engineering design and production path only from the list of elective courses

3 – **Students interested in general path**: choose elective courses without follow any path

List of Elective course -1

Course Code	Course Title	Weekly Distribution of Credit Hours				Prerequisites
		Lectures	Lab	Credit Hours	Contact Hour	
First Year - First Level						
321 GE-2	Knowledge Management	2	-	2	2	--
322 GE-2	Design Thinking	2	-	2	2	--
323 GE-2	System Dynamics	2	-	2	2	--

List of Elective courses (2), (3), (4) and (5)

Path	Course Code	Course Title	Weekly Distribution of Credit Hours				Prerequisites
			Lectures	Lab	Credit Hours	Contact Hour	
Power Engineering	531-ME-3	Internal Combustion Engines	2	1	3	4	413-ME-3
	532-ME-3	Energy Conversion	3	-	3	3	422-ME-3
	533-ME-3	Power Plants	2	1	3	4	413-ME-3
	541-ME-3	Energy Efficient Buildings.	3	-	3	3	413-ME-3
	542-ME-3	Desalination	3	-	3	3	422-ME-3
	543-ME-3	Refrigeration and Air Conditioning	2	1	3	4	413-ME-3
Design and Production	534-ME-3	Computer Aided Manufacturing	2	1	3	4	311-ME-3
	535-ME-3	Mechanical Behavior of Materials	2	1	3	4	211-ME-3
	536-ME-3	Composite Material	3	-	3	3	211-ME-3
	544-ME-3	Fundamentals of Heat Treatment	2	1	3	4	211-ME-3

Engineering	545-ME-3	Finite Element Analysis in Mechanical Design	1	2	3	5	421-ME-3 419 MATH-3
	546-ME-3	Nano technology	3	-	3	3	211-ME-3

Course Title	Engineering Drawing	**Coordinator**			
Course Code	111-GE-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**6**
Prerequisites	NA	**Level / Year**		**3/2**	
Mandatory course					

Course Objectives:

- Recognize the principles of engineering drawing.
- Acquire imagination skills for projections of engineering parts.
- Master the use of engineering drawing tools.

Teaching Method:
Lectures, Tutorial

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Identify the principles of engineering drawing related to isometric, orthographic projection, and sectioning.
CLO-2: Use imagination skills in projections of engineering parts.
CLO-3: Practice the use of engineering drawing tools.

Course Contents:	
Unit 1: Introduction	drawing instruments and their uses; lines, lettering, and dimensioning.
Unit II:	Geometrical construction, orthographic projection—first angle projections.
Unit III:	orthographic projection& isometric projection.
Unit IV: Atomic diffusion	Section of Solids
Unit V:	Missing Views

Textbook (s):

- David E. Goetsch, William S. Chalk, Raymond L. Rickman, John Nelson. Technical Drawing and Engineering Communication, 6th Edition, 2010. (ISBN: 1111321752, 9781111321758)

- By Frederick E Giesecke, Ivan L Hill, Henry C Spencer, Alva Mitchell, John T Dygdon, James E. Novak, Shawna Lockhart, Marla Goodman. Technical Drawing with Engineering Graphics, 14th Edition, 2010. Peachpit Press. (ISBN: 1292038586, 9781292038582)

Reference Book (s):

- Colin Simmons Dennis Maguire, Manual of Engineering Drawing, 4th Edition. Technical Product Specification and Documentation to British and International Standards, Elsevier, 2012. (ISBN: 0080966535, 9780080966533

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..……..…..(30 %)
Classworks…….. ……..…….. …….(20 %)
Homeworks……..……..……... (20%)
Final Exam. ……..…….……. …….. (30 %)

Course Title	Materials Science	**Coordinator**			
Course Code	211-ME- 3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	107-CHEM-4 129 -PHYS-4	**Level / Year**		**3/2**	
Mandatory course					

Course Objectives:
This course covers and concentrates on principles of material science such as atomic structure and interatomic bonding, the crystal structure of materials, theory of diffusion, imperfections in crystals, mechanical testing and evolution of materials, phase diagram and cooling curves of metals and alloys, iron-carbide diagram for steel and cast iron.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Select theories of diffusion and explain the imperfection of crystals
CLO-2: Classify different types of material types based on their properties
CLO-3: Analyse the phases and distinguish invariant reactions of phase diagrams
CLO-4: Assess the structure of metals on a macro/micro scale

Course Contents:	
Unit 1: Introduction	Learning Objectives Historical Perspective Classification of Materials Advanced Materials
Unit II: Crystal structure	Unit Cells Metallic Crystal Structures Crystallographic Points, Directions, Plans Crystal Systems
Unit III: Crystal imperfections	Point Defects Dislocations Plan Defects
Unit IV: Atomic diffusion	Diffusion Mechanisms Fick's First Law Fick's Second Law Factors That Influence Diffusion
Unit V: Mechanical properties and behaviour	Elastic Deformation Plastic Deformation Tensile Properties Hardness
Unit VI: Phase diagram Iron-iron carbide diagram	Definitions and Basic Concepts Binary Phase Diagrams Binary Eutectic Systems Development of Microstructure The iron-Carbon System Development of Microstructure in iron-Carbon System
Unit VII: Principle of heat treatment of ferrous alloy	Annealing Processes Normalizing Spheroidizing
Unit VIII: Corrosion	Electrochemical Considerations Forms of Corrosion Corrosion Prevention

Textbook (s):

William D. Callister Jr., David G. Rethwisch, " Materials Science and Engineering", Wiley 10th Edition (2018)
ISBN: 978-1-119-40549-8

Reference Book (s):

R V. Raghavan, Materials Science and Engineering: A First Course 6th Edition, Kindle Edition, PHI Learning (2015)
ISBN-13: 978-8120324558 ISBN-10: 8120324552

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..…….……..…..(30 %)
Quizzes and Assignments ……..…….. …….(20 %)
Lab reports ……..……..……... (10%)
Final Exam. …….…….……. …….. (40 %)

Course Title	Engineering Mechanics (Statics)	**Coordinator**			
Course Code	212-ME-2	**Credit Hrs.**	**2**	**Contact Hrs.**	**2**
Prerequisites	NA	**Level / Year**		**3/2**	
Mandatory course					

Course Objectives:
This course covers major topics such a Introduction to Engineering mechanics, General Principles - Force and Force Vectors, Moments, Equilibrium of a Particle - Force System and Resultants, The concept of static torsors (Center gravity and Moment of Inertia), Structural analysis, Frictions etc.

Teaching Method:
Lectures, Tutorial

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Apply the basic concepts of statics, calculation of the moment, resultant force, and couples.
CLO-2: Describe the center of gravity of a rigid body.
CLO-3: Solve and interpret problems of static of real rigid body.
CLO-4: Construct the shear-bending diagram and plot the curve.

Course Contents:	
Unit 1:	Introduction to Engineering mechanics
Unit II:	General Principles - Force and Force Vectors, Moments
Unit III:	Equilibrium of a Particle - Force System and Resultants
Unit IV:	The concept of static torsors (Center gravity and Moment of Inertia)
Unit V:	Bending moment of rigid bodies
Unit VI:	Structural analysis
Unit VII:	Friction

Textbook (s):

- Meriam, J. and L.G. Kraige, " Engineering Mechanics: SI Version. Statics", John Wiley and Sons Inc, 2013. (ISBN: 1118164997, 9781118164990)
- Vector Mechanics for Engineers, Statics, 7th Edition, F. B. Beer, E. R. Johnston, W. L. Clausen, McGraw Hill, 2003.

Engineering Mechanics-Statics, 14th Edition, Russell C. Hibbeler -Prentice Hall (2015).

Course Title	Production technology and workshop	**Coordinator**			
Course Code	221-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**5**
Prerequisites	111-GE-3	**Level / Year**		**4/2**	
Mandatory course					

Course Objectives:
This course covers the fundamentals of manufacturing processes and its basic Concepts for example metal casting, welding process, sheet metal casting , carpentry, automobile and electrical workshop.

Teaching Method:
Lectures, Lab, Tutorial

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Identify processes, materials, techniques, practices, conventions, and/or terminology in mechanical engineering
CLO-2: Application of Engineering Principles and theoretical concepts.

Course Contents:	
Unit 1:	Introduction to production engineering
Unit 2:	Introduction to industrial safety
Unit 3:	Engineering materials and Their properties
Unit 4:	Engineering measurements
Unit 5:	Metal casting processes
Unit 6:	Sheet metal work and fitting
Unit 7:	Joining of metals
Unit 8:	Principals of machining
Unit 9:	Carpentry workshop
Unit 10:	Automotive Engg /Electrical Engg

Textbook (s):
W. Scott Gauthier, "Automotive Encyclopedia: Fundamental Principles, Operation, Construction, Service, and Repair" 7th edition, Goodheart-Willcox Publisher, 2000, ISBN: 1566377153, 9781566377157

Chakrabarti, Basic Electrical Engineering, Tata McGraw-Hill Education, 2009, ISBN:0070669309, 9780070669307

Reference Book (s):

R. Thomas Wright, Processes of Manufacturing, Edition 4, Goodheart-Willcox, 2004, ISBN:1590703626, 9781590703625

John A. Schey, "Introduction to Manufacturing Processes", (McGraw-Hill Series in Mechanical Engineering & Materials Science), 2000., ISBN: 0071169113, 9780071169110

W Chapman: "Workshop Technology". Vol.: 1, 2. 4th edition Routledge, 2019, ISBN: 1136898549, 9781136898549

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..……..…..(30 %)
Quizzes and Assignments ……..…….. …….(15 %)
Lab reports ……..……..……... (15%)
Final Exam. …….…….……. …….. (40 %)

Course Title	Thermodynamics-1	**Coordinator**			
Course Code	222-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	129-PHYS-4 119-MATH-3	**Level / Year**		**4/2**	
Mandatory course					

Course Objectives:
This course covers and concentrates on principles of thermodynamics such as describing what information the First Law of Thermodynamics provides about the "directionality", or "tendency", of physical and chemical changes. To state the First and second Laws of Thermodynamics and describe their significance.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Identify the basic principles of thermodynamics
CLO-2: Devise the concept of energy and define its various forms
CLO-3: Apply the first law of thermodynamics to various systems
CLO-4: Use the appropriate formulas and solve the engineering problems based on thermodynamic principles
CLO-5: Collect and analyse data through the experiments based on principles of thermodynamics

Course Contents:	
Unit 1:	Introduction
Unit 2:	Fundamental concepts and definitions
Unit 3:	Properties of pure substances
Unit 4:	Work and heat
Unit 5:	First law of thermodynamics and its applications
Unit 6:	The second law of thermodynamics
Unit 7:	Air-standard Brayton cycle
Unit 8:	Entropy, reversibility, and irreversibility
Unit 9:	Applications of steady state and steady flow
Unit 10:	Uniform flow and some processes

Textbook (s):

Cengel, Yunus A., Michael A. Boles, and Mehmet Kanoğlu. Thermodynamics: an engineering approach. New York: McGraw-hill, 2023

Reference Book (s):

Moran, Michael J., et al. Fundamentals of engineering thermodynamics. John Wiley & Sons, 2010.

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..……..…..(30 %)
Quizzes and Assignments ……..…….. …….(15 %)
Lab reports ……..……..……... (15%)
Final Exam. …….…….……. …….. (40 %)

Course Title	Strength of Materials and Testing	**Coordinator**			
Course Code	223-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	211-ME-3	**Level / Year**		**4/2**	
Mandatory course					

Course Objectives:
The main purpose of studying strength of materials and their testing in mechanical engineering is to provide graduate engineers with the means of analyzing and designing various machines components and load-bearing structures. Both analysis and design of a given structure involve the determination of stress and strain. Then, student - engineers will be able to select/calculate/define the suitable material/loads/dimensions for a given application under a given condition. This course has been carefully designed to meet the students' basic needs at this level.

Teaching Method:
Lectures, Lab, Tutorial

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Outline general objectives of strength of materials
CLO-2: Relate internal loads and type of loading
CLO-3: Calculate normal stress and shear stress
CLO-4: Analys simple design problems

Course Contents:	
Unit 1:	Introduction to strength of materials and static review, general objective and assumptions of strength of materials, internal loads, different types of loading
Unit 2:	Tension, compression, normal stress, normal strain, mechanical properties, Hooke's law, Poisson ratio, allowable stress
Unit 3:	Deformation of Axially Loaded Members, thermal stress and Thermal Strain, Shear stress, Shear strain, Hooke's law, shear modulus
Unit 4:	Torsion formulas, polar moment, Angle of Twist, Torsion of Solid Non-Circular Sections
Unit 5:	Thin walled pressure vessels, longitudinal and transversal stresses in cylindrical vessels, stress in spherical vessels
Unit 6:	Pure bending, bending stress, moment of inertia of sectional area, radius of gyration
Unit 7:	Shear Force and Bending Moment diagram

Unit 8:	Stress and strain transformations, General equations of plane stress and strain Principal Stresses, Maximum in-plane shear stress and strain, Mohr's Circle, Triaxial stress and strain, Absolute Maximum shear strain

Textbook (s):

1.Mechanics of Materials (8th Edition) Hardcover – April 1, 2010 by Russell C. Hibbeler (Author) ISBN-13: 978-0136022305 ISBN- 10: 0136022308 Edition: 8th

2. Mechanics of Materials Hardcover – January 4, 2011 by Ferdinand Beer (Author), Jr., E. Russell Johnston (Author), John DeWolf (Author), David Mazurek (Author) ISBN-13: 978-0073380285 ISBN-10: 0073380288 Edition: 6th

Reference Book (s):

Mechanics of Materials, Hardcover – April 1, 2010, by Russell C. Hibbeler (Author) ISBN-13: 978-0136022305 ISBN- 10: 0136022308

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..……..…..(30 %)
Quizzes and Assignments ……..…….. …….(15 %)
Lab reports ……..……..……... (15 %)
Final Exam. ……..…….……. …….. (40 %)

Course Title	Creativity & Innovation	**Coordinator**			
Course Code	221-GE-2	**Credit Hrs.**	**2**	**Contact Hrs.**	**2**
Prerequisites		**Level / Year**		**4/2**	
Mandatory course					

Course Objectives:
Upon completing this course, it is expected that students will be able to:
Creativity and innovation are integral to an organization's ability to survive and thrive in today's competitive marketplace. The main purpose of the course is to provide ample training and exposure to the students to be able to work independently and innovatively in new projects and work assignments. The specific aim is to inculcate innovation-based thinking ability to approach professional challenges.

Teaching Method:
Lectures, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Combine the roles of skill, experience, motivation and culture in creative endeavor
CLO-2: Illustrate some potential disruptive innovations and take advantage of 'open' innovation
CLO-3: Analyse case study analysis skills (specifically, identifying critical issues in case studies and applying course material to case studies).
CLO-4: Assist the process involved in managing creativity or innovation effectively and apply this knowledge to your own creative idea or innovation
CLO-5: Analyze the influence of problem-solving techniques, team processes, and environmental conditions on creativity in organizations.

Course Contents:	
Unit 1:	What is creativity and innovation
Unit II:	The need for creativity, invention and innovation
Unit III:	Sources of, and barriers to creativity & innovation
Unit IV:	Creativity tools
Unit V:	Creative thinking and idea generation
Unit VI:	Types and dimensions of innovation
Unit VII:	The innovation processes
Unit VIII	The need for creativity, invention and innovation
Unit VIIII	Sources of, and barriers to creativity & innovation

Textbook (s):

Boynton, Andy and Fisher, Bill. The Idea Hunter: How to find the best ideas and make them happen. Jossy-Bass A Wiley Imprint, 201

Reference Book (s):

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..……..…..(30 %)
Quizzes and Assignments ……..…….. …….(30 %)
Final Exam. …….……. ……. (40 %)

Course Title	Engineering Programming	**Coordinator**			
Course Code	103-CMS-3	**Credit Hrs.**	**2**	**Contact Hrs.**	**3**
Prerequisites	104CMS-2 Computer Science	**Level / Year**		**4/2**	
Mandatory course					

Course Objectives:

- Understand the programming basics in Python (operations, control structures, data types, etc.).
- Understand various data types and control structure in Python.
- Gain proficiency in using Python modules and libraries for scientific computing and data analysis.
- Evaluate the outcome of Python code.
- Develop the ability to collaborate with others to read and write Python programs for mechanical engineering applications.
- Apply computer programming in Python to solve engineering problems.
- Improve problem-solving skills using computational methods

Teaching Method:
Lectures, Lab

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO-1: Practice the programming basics in Python
CLO-2: Use various data types and control structure in Python
CLO-3: Develop proficiency in using Python modules and libraries for scientific computing and data analysis
CLO-4: Evaluate the outcome of Python code
CLO-5: Apply computer programming in Python to solve engineering problems
CLO-6: Improve problem-solving skills using computational methods
CLO-7: Participate with others to read and write Python programs for mechanical engineering application

Course Contents:	
Unit 1:	Introduction to Python Programing
Unit II:	The Core Python Language I
Unit III:	Simple Plots and Charts
Unit IV:	The Core Python Language II
Unit V:	NumPy
Unit VI:	Matplotlib

Unit VII:	SciPy
Unit VIII:	Data Analysis with Pandas

Textbook (s):

Learning Scientific Programming with Python 2nd Edition by Christian Hill.
ISBN 9781108745918 (paperback)
ISBN 9781108778039 (epub)

Reference Book (s):

- Applied Numerical Methods with Python for Engineers and Scientists, 1st Edition By Steven Chapra and David Clough
  ISBN10: 1266651497
  ISBN13: 9781266651496
- Python 3.11.2 documentation, the book is available freely on the official website at (https://docs.python.org/3.11/).
- "Starting Out with Python (4th Edition), Tony Gaddis
  ISBN- 13: 978-1-292-22575-3"
- Python and other contemporary programming languages have extensive online documentation. They were created with the expectation that programmers would interact with this documentation frequently and wouldn't need to recall more than a small amount of it. As a result, this course's background will draw on a variety of readily accessible web resources.

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..…….……..…..(30 %)
Quizzes and Assignments ……..…….. …….(20 %)
Lab reports ……..……..……... (10%)
Final Exam. …….…….……. …….. (40 %)

Course Title	Metal Cutting Processes	**Coordinator**			
Course Code	311-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	211ME-3 221ME-3	**Level / Year**		**5/3**	
Mandatory course					

Course Objectives:
The main aim of this course is to make the students to understand the basic knowledge needed for engineers in the field of conventional and non-conventional machining and develop his information in estimation of machining times and planning of the suitable technological procedures for some machining operations.

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Identify the basics and fundamentals of machining metals and alloys
CLO2: Outline the features and details of each machining techniques
CLO3: Use machines to shape jobs of various materials
CLO4: Estimate the machining times and the machining forces for a job
CLO5: Demonstrate ability to work in teams to machine some components
CLO6: Show self-confidence to work without supervision

	Course Contents:
1	Definitions and basics of manufacturing processes; Classification of manufacturing processes; Definition and purpose of machining.
2	Tool-Work motions and elements of machining for different machining operations.
3	Tool Geometry of single point cutting tool; Tool signature and tool nomenclature by American standard Association system (ASA).
4	Rake Angle, clearance angle and its significance; Metal cutting operation, formation, and types of chips.
5	Shear Angle and Geometry of chip formations; Mechanics of chip formation, Relationship between Velocity of cut (Vc), Flow velocity (Vf) and Shear velocity (Vs); Numerical problem based on these relationships.
6	Tool materials commonly used for single point cutting tools and its properties; Cutting fluids: types, application, properties
7	Tool wear and Tool Life, Taylor's tool life equation and tool life plots; Problems based on tool life.
8	Definition, classification, and basic elements of machine tools; Kinematics of center lathe machine; common turning operation performed on lathe machine; Numerical problems based on machining time.
9	Hole-making operations: Drilling, Reaming, Boring, Tapping operations, twist drill geometry; types of drills; drilling machine; drilling time
10	Reciprocating machine tools: shaper, planning machine and slotting operations, milling machine: types, operations, mechanics, milling time
11	Abrasive processes: Grinding, Honing, Lapping; grinding wheel designation and selection; types of grinding machines and process parameters
12	Non-conventional machining process: Electric Discharge Machining, Electro Chemical Machining

13	Ultrasonic Machining, Laser Beam Machining, Plasma Arc Machining, Abrasive Water Jet Machining
14	Revision

Textbook (s):

Serope Kalpakjian and Steven R Schmid, “Manufacturing Processes for Engineering Materials”, Pearson Education Limited, 2008

David A. Stephenson, John S. Agapiou, "Metal Cutting Theory and Practice "Taylor & Francis Group, 2006

Reference Book (s):

Benjamín W. Niebel, Alan B. Draper, Richard A. Wysk, “Modern Manufacturing Process Engineering”, McGraw-Hill, 2002

Mikell P. Groover, “Fundamentals of Modern Manufacturing: Materials, Processes, and Systems”, John Wiley & Sons, 2010

Mode of Evaluation:	Percentage
Quiz.1	5
Assignment 1	5
Midterm 1	15
Quiz.2	5
Assignment 2	5
Midterm 2	15
Lab Report	5
Lab Exam	5
Final exam	40
Total	100

Course Title	Mechanical Engineering Drawing	**Coordinator**			
Course Code	312-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**5**
Prerequisites	111-GE-3	**Level / Year**		**5/3**	
Mandatory course					

Course Objectives:
To enable students to recognize and create assembly drawings as well as illustrate and interpret engineering drawing standards used for assembly drawings. Use the SolidWorks mechanical design automation software to build parametric models of parts and assemblies, and how to make drawings of those parts and assemblies.

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Sketch different types of sections in machine drawings
CLO2: Use SolidWorks Software with confidence and design/draft the new innovative parts
CLO3: Use CAD-Software, such as SolidWorks software, in machine drawing

	Course Contents:
1	Introduction about the subject, Vision Mission of KKU, COE, MED, PEOs, SLOs, SLOs Syllabus, general requirements, evaluation procedure and distribution of marks. Answer students' queries and doubts.
2	Chapter 1: Overview of an Engineering Drawing
3	Conventional Practices for Orthographic Projections: Half Views, Partial Views, and Aligned Views.
4	Chapter 2: Sections
5	Conventional Practices in Sectional views: Conventions for Ribs, Webs, Spokes, and lugs in Full Sectional View, Broken Section.
6	Conventional Practices in Sectional views: Removed Section, Revolved Section, Offset Section, and Auxiliary Sectional Views. Simplified Representations of Standard Machine Elements.
7	Chapter 3: Joints and Fasteners
8	Welded and Riveted Joints
9	Threaded Fasteners
10	Chapter 4: Limits, Fits and Tolerances
11	Symbols and Surface Finish.
12	Revision Revision and Guidelines for Final Exam

Textbook (s):
K. L. Narayana, P. Kannaiah, and K. Reddy, "Machine Drawing", 5th Edition, 2016, New Age International Ltd. Publishers. ISBN: 978-81-224-4054-6

Reference Book (s): Colin H. Simmons, Dennis E. Maguire, Neil Phelps, “Manual of Engineering Drawing”, 3rd Edition, 2009, Elsevier Ltd. ISBN: 978-0-7506-8985-4. Bertoline−Wiebe, “Engineering Graphics – Fundamentals of Graphics Communication”, 5th Editions, 2006, McGraw-Hill, ISBN: 0-390-73230-3.	
Mode of Evaluation:	**Percentage**
Midterm Exam 1	15
Midterm Exam 2	15
Quizzes and Assignment	10
Classwork	20
Final exam	40
Total	100

Course Title	Engineering Mechanics (Dynamics)	**Coordinator**			
Course Code	313-ME-2	**Credit Hrs.**	**2**	**Contact Hrs.**	**2**
Prerequisites	NA	**Level / Year**		**5/3**	
Mandatory course					

Course Objectives:
State the principles of dynamics and outline the principles for the idealizations of Statics and Dynamics
Apply the principles of dynamics to solve engineering problems
Evaluate and illustrate basic engineering problems independently or in a group.

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Apply the principles for the idealizations of Statics and Dynamics problems
CLO2: Choose the procedure to solve the problems by using the laws and principles of dynamics
CLO3: Apply newtons laws motions to dynamics problems
CLO4: Solve kinetics and kinematics problems
CLO5: Develop Freebody diagrams to evaluate problems of particle and rigid body dynamics
CLO6: Illustrate problems of dynamics in groups

	Course Contents:
1	Introduction
2	Center of gravity and Moment of Inertia
3	Moment of Inertia (Tutorials)
4	Kinematics of Particles
5	Kinematics of Particles-Rectilinear Motion
6	Kinematics of Particles-Projectiles
7	Kinematics of Particles-Curvilinear Motion
8	Kinetics of Particles - Force-and-Acceleration
9	Kinetics of Particles - Work-and-Energy
10	Kinetics of Particles - Impulse-and-Momentum
11	Planar Kinematics of Rigid Bodies
12	Planar Kinetics of Rigid Bodies
13	Free Vibration of Particles
14	Revision

Textbook (s):

Vector Mechanics for Engineers, Dynamics, 7th Edition, F. B. Beer, E. R. Johnston, W. L. Clausen, McGraw Hill, 2003.

• Engineering Mechanics Dynamics, 14th Edition, Russell C. Hibbeler - Prentice Hall (2015).

Reference Book (s):

Engineering Mechanics: Dynamics, 1st Computational Edition, R. W. Soutas-Little, D. J. Inman, CL-Engineering, 2007

Mode of Evaluation:	**Percentage**
Midterm Exam I	15
Midterm Exam II	15
Assignments	10
Quiz	10
Homework	10
Final Exam	40
Total	100

<table>
<tr><td>1. Course Number</td><td>321-ME-3</td><td>Course Name</td><td>Theory of Machines</td></tr>
<tr><td>2. Credit hours</td><td>2 L + 1 T/P = 3</td><td>Contact hours</td><td>2L + 2T/P = 4 per week</td></tr>
<tr><td>Level / Year</td><td colspan="3">6/3</td></tr>
<tr><td>3. Course Instructor</td><td colspan="3">Dr. Vineet Tirth
Office No. 1-2-85</td></tr>
<tr><td>Tutorial/Practical Instructor</td><td colspan="3">Dr. Vineet Tirth
Office No. 1-2-85</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="3">Textbook:
Theory of Machines; R.S. Khurmi and J.K. Gupta; S. Chand and company Ltd.; New Delhi.
a. Other supplemental materials:
1. Theory of Machines; SS Rattan: Tata McGraw Hill, New Delhi.
2. J. E. Shigley, J. J. Uicker, Theory of machines and mechanisms.
3. Mechanism and Machine Theory; J S Rao and Dukkipati; Wiley Eastern, New Delhi.
4. Theory of Mechanism and Machine; A Ghosh and AK Malik, East West Press (Pvt.) Ltd., New Delhi.</td></tr>
<tr><td>5. Specific course information</td><td colspan="3">a. Brief description of the content of the course (catalog description)
This course covers the theory, design, performance, and principles of motion; position; velocity and acceleration of rigid bodies. It also includes the design of cams and analysis of gears and governors. Introduction to gyroscope and balancing of masses are also included. Emphasis is given on applications and design of mechanisms by real life assignments. The subject has four credit hours and five contact hours per week; three hours for lectures and two hours for practical/tutorial. The demonstration of mechanisms is given in lab sessions and the problems are solved in tutorial sessions.
Theory of machines is a core mechanical engineering subject and a prerequisite for machine design. The conventional method of classroom interaction using multimedia teaching aids and animations/videos will be used for lecture sessions. The communication between the instructor and the students will be regularly maintained using blackboard interface.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="3">--</td></tr>
<tr><td>Co-requisites</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Required</td><td>Language of instruction</td><td>English</td></tr>
<tr><td>Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
</table>

L Lecture; T Tutorial; P Practical

6. Specific goals for the course

a. Specific outcomes of instruction

By the completion of the course the student should be able to:

CLO1 PI 1.1 Define basic concepts of links, degree of freedom, machines and mechanisms. SO1, KLO1

CLO2 PI 1.3 Calculate velocity of basic mechanisms. SO1, KLO1

CLO3 PI 2.6 Construct the displacement diagram and cam profile. SO2, KLO2

CLO4 PI 1.2. Solve problems on Gears and Governors. SO1, KLO1

CLO5 PI 2.6. Evaluate mechanisms for different applications. SO2, KLO2

b. Course Learning Outcomes (Mapped with Student Outcome of Criteria 3)

CLO#	MEP Rubrics: Performance Indicator	ABET SO#	NCAAA KLO#
CLO1	1.1	1	1
CLO2	1.3	1	1
CLO3	2.6	2	2
CLO4	1.2	1	1
CLO5	2.6	2	2

7. Brief list of topics to be covered

1.	Introduction: Links, Joints, Pairs, Degree of Freedom, Difference between Structures, Mechanisms and Machines. Simple and Complex Mechanisms.	8
2.	Mechanisms: Analysis of Mechanisms, Four Bar Mechanisms, Crank and Slider Mechanisms, Crank and Slotted Lever Quick Return Mechanism, Whitworth Quick Return Mechanism.	10
3.	Analysis of Velocity in Mechanisms: Velocity of a point on a link, Linear and Angular Velocity of Links, Velocity Analysis using graphical methods for Four Bar Mechanism, Crank and Slider Mechanism, Complex Mechanism.	12
4.	Analysis of CAM and Follower Mechanisms Introduction to types of CAMs and Followers, Analysis of Roller and Knife Edge Followers with Uniform Velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation, Cycloidal Motion, Radial and Offset CAMs.	12
5.	Gears Different types of Gears, Analysis of Simple and Compound Gears, Gear Trains, Internal and External Gears, Inverted Gears, Epicyclic Gears.	9
6.	Governors Introduction to Governors, Types of Governors, Watt and Porter Governors.	5

8. Any other information

Course Assessment*

	Activity	Assessment% (Marks)
	Mid Exam 1 (Mandatory)	15% (15 Marks)
	Mid Exam 2 (Mandatory)	15% (15 Marks)
	Quiz (Blackboard)	10% (10 Marks)
	Project/Assignment	5% (5 Marks)
	Tutorial Sheets and Practical	15% (15 Marks)
	Final Exam	40% (40 marks)
	Total	100% (100 Marks)

***Subject to Approval by the College of Engineering/Department Administration**

Course Title	Fluid Mechanics	**Coordinator**			
Course Code	322-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	222-ME-3	**Level / Year**		**6/3**	
Mandatory course					

Course Objectives:
It's to introduce the main topics of fluid mechanics to mechanical engineering students

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Use the basics concepts of fluid mechanics
CLO2: Use of engineering judgement through practical experiments in fluid mechanics
CLO3: Collect and analyse data through experiments in fluid mechanics.

	Course Contents:
1	Introduction
2	Fluid definition -Dimensions and units
3	Fluid properties
4	Fluid Statics
5	Buoyancy and Stability of floating body
6	Fluid Kinematics
7	Fluid Dynamics
8	Energy Principles

Textbook (s):
Clayton T. Crowe , Donald F. Elger and John A. Roberson, Engineering Fluid Mechanics", John Wiley& Sons, Inc., 8th Ed., 2006

Reference Book (s):
Robert W. Fox, Alan T. McDonald and Philip J. Pritchard "Introduction to Fluid Mechanics

Mode of Evaluation:	**Percentage**
Homeworks	5
Midterm	15
Midterm	15
Quizzes	5
Lab Reports	10
Lab Exam	5
Project	5
Final Exam	40

Course Title	Machine Elements Design-1	**Coordinator**			
Course Code	411-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	223-ME-3 312-ME-3	**Level / Year**		**7/4**	
Mandatory course					

Course Objectives:
Recognize the difference between theory and the applied design.
Know different design theories and their applications.
Analyse forces and calculate principal stresses.
Acquire skills in designing simple machine parts.
Acquire skills in using computer in design and drawing

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Distinguish between theory and the applied design
CLO2: Apply engineering analysis principles and methods to the proper analysis of a variety of common mechanical system components
CLO3: Design mechanical system components so as to perform safely their intended functions in harmony with other components of the system
CLO4: Use information resources to identify appropriate and elegant component solutions for mechanical system design problems, locate sources for these components, and understand the analysis and design methods for these components

	Course Contents:
1	Introduction to design processes, types of stresses, and material selection, Failure theories: static and dynamic.
2	Design of joints: riveted, welded, screwed, and cotter and knuckle joints
3	Couplings design: rigid and flexible
4	Clutches design.
5	Brakes design
6	Springs design
7	Chain drives
8	Power screws design

Textbook (s):

Khurmi, R.S. & Gupta, J.K., "Machine Design", Eurasia Publishing House, 14th Edition (2005) ISBN-10 : 8121925371 ISBN-13 : 978-8121925372
Shigley, J.E., "Mechanical Engineering Design", McGraw Hill, Inc., 10th Edition.ISBN-13: 978-0073398204 ISBN-10: 9780073398204
Robert C. Juvinall& Kurt M. Marshek, "Fundamentals of Machine Components Design", 5th Edition, John Wiley & Sons Inc., 2012, ISBN 9781118012895.
Robert L. Mott, "Machine Elements in Mechanical Design", 3rd Edition, Prentice Hall, 1999.
Avallone, E.A., Baumeister, T., "Marks Standard Handbook for Mechanical Engineers", 11th Edition, McGraw Hill, 2007

Reference Book (s):

Robert C. Juvinall& Kurt M. Marshek, “Fundamentals of Machine Components Design”, 5th Edition, John Wiley & Sons Inc., 2012, ISBN 9781118012895.

Robert L. Mott, “Machine Elements in Mechanical Design”, 3rd Edition, Prentice Hall, 1999.

Avallone, E.A., Baumeister, T., “Marks Standard Handbook for Mechanical Engineers”, 11th Edition, McGraw Hill, 2007.

Mode of Evaluation:	**Percentage**
Quiz-1, Quiz-2 & Quiz-3	15
Midterm-1 & Midterm-2	30
Tutorial	10
Assignment	5
Final Exam	40
Total	100

Course Title	Metal Forming Process	**Coordinator**			
Course Code	412-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	211-ME-3 221-ME-3	**Level / Year**		**7/4**	
Mandatory course					

Course Objectives:
This course covers and concentrates on principles of material science such as atomic structure and interatomic bounding, crystal structure of materials, theory of diffusion, imperfections in crystals, mechanical testing and evolution of materials, phase diagram and cooling curves of metals and alloys, iron-carbide diagram for steel and cast iron

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: State principles of the forming properties such as fusibility, plasticity, and ductility and choosing the proper processes forming methods
CLO2: Differentiate various casting processes and Forming Processes
CLO3: Compare various composite fabrication processes
CLO4: Show self-confidence to work without supervision in production lab
CLO5: Demonstrate ability to work in teams to weld different materials

	Course Contents:
1	Introduction to casting and different casting techniques. Molding materials and their properties. Sand casting technology, Melting furnaces.
2	Solidification of pure metals and alloys. casting defects. Quality control in sand casting. Permanent die casting, Investment casting. Continuous casting.
3	Introduction to plastic deformation processes. Extrusion process of metals, Types of Extrusion, Characteristics of extrusion, Extrusion Machines Die Design , Defects , materials, Applications, Numerical Problems.
4	Forging of metals, Types of forging process , Forging Equipment's, Defects, Die Design , Forging materials, Applications, Numerical Problems. Principles of Rolling process, Types Rolling process and machines, Defects, Advantages, Applications Numerical Problems.
5	Introduction to welding and different welding processes. Soldering, brazing techniques. Fusion welding processes, shielded metal arc welding, Gas metal arc welding, Gas tungsten arc welding. Solid state welding. Welding defects, Welding inspection, Welding symbols.
6	General Introduction about material fabrication techniques.
7	Introduction to ceramics, types of ceramics, forming techniques of glass ceramics, Casting, spinning, pressing, Blowing, drawing, production of glass fibers, Heat treatment of glasses. Fabrication of clay products; Hydro plastic forming, slip casting, Powder pressing, tape casting.
8	Introduction to Polymer Additives.
9	Introduction to Fabrication of polymers Extrusion, injection molding, blow molding, Thermoforming, compression molding, Casting, vacuum forming.
10	Micro/Nano Injection molding

11	Additive Manufacturing Technology (3D Printing)
12	Introduction to Materials Characterizations Techniques

Textbook (s):

Degarmo, E.P., Black, J.T., and Kohser R. A., "Materials and Processes in Manufacturing", 9th, Edition, 2002.

Kalpakjian, S. & Schmid, S.R., "Manufacturing Engineering and Technology", 6th ed. Prentice Hall, 2009.

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 4th Edition (ISBN 978-0470-467002).

J.P. Beaumont, M. Smith, Runner and gating design handbook: tools for successful injection molding, 3rd ed., Hanser Publications, Cincinnati, 2019.

Reference Book (s):

Degarmo, E.P., Black, J.T., and Kohser R. A., "Materials and Processes in Manufacturing", 9th, Edition, 2002.

Kalpakjian, S. & Schmid, S.R., "Manufacturing Engineering and Technology", 6th ed. Prentice Hall, 2009.

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 4th Edition (ISBN 978-0470-467002).

J.P. Beaumont, M. Smith, Runner and gating design handbook: tools for successful injection molding, 3rd ed., Hanser Publications, Cincinnati, 2019.

Mode of Evaluation:	**Percentage**
Midterm Exam 1	15
Midterm Exam 2	10
Quizzes, Project and Assignment	20
Lab	15
Final exam	40
Total	100

Course Title	Heat Transfer	**Coordinator**			
Course Code	413-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	322-ME-3	**Level / Year**		**7/4**	
Mandatory course					

Course Objectives:
It's to introduce the main heat transfer topics to mechanical engineering students

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Identify the basic concepts in heat transfer
CLO2: Develop experimental skills in engineering applications in heat transfer.
CLO3: Examine the data obtained through the experiments in heat transfer

	Course Contents:
1	Introduction to heat transfer
2	Modes of Heat Transfer & Electric Circuits.
3	Steady State Conduction.
4	Fins & Extended Surfaces
5	Unsteady State Conduction
6	Free Convection.
7	Forced Convection.
8	Radiation
9	Heat Exchangers

Textbook (s):
Theodore L. Bergman and Adrienne S. Lavine, "Fundamentals of heat and Mass transfer",WILEY ,8th Ed., 2017
ISBN-9781119337676
ISBN-9781119320425

Reference Book (s):
Yunus A. Cengel and Afshin J. Ghajar, "Heat and Mass Transfer Fundamentals & Applications", McGraw-Hill Education, 8th Ed., 2011

Mode of Evaluation:	**Percentage**
Midterm Exam 1	15
Midterm Exam 2	15
Quizzes and Assignment	15
Lab	15
Final exam	40
Total	100

Course Title	Measuring Devices	**Coordinator**			
Course Code	414-ME-2	**Credit Hrs.**	**2**	**Contact Hrs.**	**3**
Prerequisites	321-ME-3	**Level / Year**		**7/4**	
Mandatory course					

Course Objectives:
Understand the basic principles of measurement and device usage.
Know the different measurement ways in the mechanical engineering field.
Gain the skills of using the different measuring devices in the mechanical engineering field.
Gain the accuracy skills in the different measurement operations.

Teaching Method:
Traditional classroom, E-learning, Hybrid, Distance learning

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Define basic concepts of Measurement, Metrology, Error, Uncertainty, Accuracy and Precision
CLO2: Justify the awareness about the principles of measurement
CLO3: Calculate (directly or indirectly) correctly by hand or by using a computer program
CLO4: Analyse measurement data sets correctly using statistical concepts, especially during the coverage of errors and uncertainty in measurements.
CLO5: Interpret safe and logical lab procedures, develop of proper plan for data gathering from the experiment to attain a stated objective, and account for errors statistically.

CLO6: Appraise independent learning by assigning and evaluating time-bound assignments/seminars/discussions by incorporating the recent topics

	Course Contents:
1	Introduction to Mechanical Measurements
2	Terminology in Mechanical measurements
3	Accuracy, Precision and Significant Digits
4	Errors in Measurement-Classification of Errors
5	Uncertainty analysis-Numerical Problems
6	Data analysis, presentation, and written report
7	Temperature Measurement
8	Pressure Measurement
9	Measurement of fluid properties, Flow measurement

Textbook (s):
S.P. Venkateshan. Mechanical Measurements (2nd Edition) (2015) John Wiley & Sons Ltd The Atrium, Southern Gate Chichester, West SussexPO19 8SQ United Kingdom
ISBN-10 : 9383656913

ISBN-13 : 978-9383656912J.P. Beaumont, M. Smith, Runner and gating design handbook: tools for successful injection molding, 3rd ed., Hanser Publications, Cincinnati, 2019.

Reference Book (s):

S.P. Venkateshan. Mechanical Measurements (2nd Edition) (2015) John Wiley & Sons LtdThe Atrium, Southern GateChichester, West SussexPO19 8SQ United Kingdom
ISBN-10 : 9383656913
ISBN-13 : 978-9383656912

Mode of Evaluation:	**Percentage**
Midterm Exam 1	15
Midterm Exam 2	15
Quizzes	10
Assignment	20
Final exam	40
Total	100

Course Title	Machine Design	**Coordinator**			
Course Code	421-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	411-ME-3	**Level / Year**		**8/4**	
Mandatory course					

Course Objectives:
Describe the concept, procedures, and data for stress analysis.
Recognize the machine elements in power transmission systems.
Acquire competency in sizing and selecting mechanical components for mechanical systems

Teaching Method:
Traditional classroom, Hybrid

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Categorize the machine elements in power transmission systems and acquire competency in sizing and selecting mechanical components for mechanical systems
CLO2: Apply the concept, procedures, and data for stress analysis
CLO3: Design and select mechanical elements according to codes and standards.
CLO4: Use failure theories for designing elements made of ductile or brittle materials.

	Course Contents:
1	Introduction to stress analyses
2	Design of shafts & keys
3	Design of Belts
4	Design of bearings
5	Design of journals
6	Types of transmissions
7	Study the different types gearboxes
8	Design of single reduction gear box

Textbook (s):
SheigleyMechnical Engineering design book 10th edition 2012

Reference Book (s):
Lingaiah, K., " Machine Design Data Handbook", McGraw Hill Inc., 1994.

Mode of Evaluation:	**Percentage**
Homework1	1
Quiz1	1.25
Homework2	1
Quiz2	1.25
Homework 3	1
Midterm 1	30
Homework4	1
Quiz3	1.25

Homework5	1
Quiz4	1.25
Presentation	20
Final exam	40

Course Title	Thermodynamics-2	**Coordinator**			
Course Code	422-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	222-ME-3	**Level / Year**		**8/4**	
Mandatory course					

Course Objectives:
To enable students to understand, define, design, and analyse different types of refrigeration and power systems

Teaching Method:
Traditional classroom

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Describe the power and refrigeration cycles
CLO2: Apply the thermodynamics relations generally and for simple compressible substances specifically
CLO3: Analyse the fuels and combustion processes in thermodynamic systems
CLO4: Apply the basics, physical concepts in the practical applications of gas mixtures

	Course Contents:
1	First and second laws of thermodynamics.
2	Power systems with phase change (Concepts of vapor power cycles and their applications: Rankine cycle for vapor power plants, Reheat cycle, and Regenerative cycle. Lab experiment: Steam turbine).
3	Refrigeration systems with phase change (Concepts of refrigeration cycles and their applications: Refrigerators and heat pumps, vapor-compression refrigeration cycle. Selection of the right refrigerant. Heat pump systems. Lab experiment: Heat pump and Industrial refrigeration system).
4	Power systems with working gaseous fluids (Concepts of gas power cycles and their applications: Otto cycle, Diesel cycle, Brayton cycle, and Jet-propulsion cycles. Lab experiment: Gas turbine and two-stage compressor).
5	Refrigeration systems with working gaseous fluids (The air- standard refrigeration).
6	Thermodynamic relations (Maxwell relations, Gibbs equation, Clapeyron equation, Clapeyron-Clausius equation, General relations for the variation of enthalpy, internal energy and entropy and specific heat, Joule-Thomson Coefficient).
7	Gas mixtures (Composition of a gas mixture. P-v-T behavior of gas mixtures. Thermodynamic properties of gas mixtures).
8	Gas-vapor mixtures and air-conditioning (Dry and atmospheric air-Specific and relative humidity of air-Dew-point and wet-bulb temperatures. The psychrometric chart. Air-conditioning processes. Lab experiment: Cooling tower).
9	Chemical reactions (Fuels and combustion and their applications. Theoretical and actual combustion processes. Enthalpy of formation and enthalpy of combustion. Steady-flow and closed reacting systems. First law analysis of reacting systems. Adiabatic flame temperature)

Textbook (s):

Yunus A. Cengel and Michael A. Boles. Thermodynamics: An Engineering Approach, 8th Ed. McGraw Hill, 2014.
ISBN-10 : 9780073398174

Reference Book (s):	
Moran, M.J., and Shapiro, H.N., Fundamental of Engineering Thermodynamics, 6th Ed., John Wiley & Sons, 2007. Borgnakke, C. and Sonntag, R. E., Fundamentals of Thermodynamics, 7th Ed., John Wiley & Sons, 2009.	
Mode of Evaluation:	**Percentage**
Midterm Exam 1	**15**
Midterm Exam 2	**15**
Quizzes and Assignment	**15**
Lab	**15**
Final exam	**40**
Total	100

Course Title	Hydraulic Machines & Fluid Power Systems	**Coordinator**			
Course Code	423-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	322-ME-3	**Level / Year**		**8/4**	
Mandatory course					

Course Objectives:
Specify the different types and applications of hydraulic machines.
Differentiate between impulse and reaction turbines.
Specify the different types and applications of pumps.
Evaluate the performance of pumps and turbines by determining hydraulic, volumetric, mechanical, and overall efficiencies.
Determine system head losses through a system.
Identify how to connect pumps in series and parallel.
Specify the basic components of fluid power system, such as pumps, actuator, valves, filters, and reservoirs.
Describe the types of hydraulic valves.
Describe the construction and design features of hydraulic cylinders.
Analyse the operation and performance of hydraulic circuits.

Teaching Method:
Traditional classroom

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Identify the hydraulic machines according to the fluid energy.
CLO2: Identify hydraulic valves and their use.
CLO3: Compare hydraulic machines according to their application.
CLO4: Calculate a pump's required pressure and flow rate for a specific application.
CLO5: Design hydraulic machines (Turbines and Pumps)
CLO6: Measure turbines and pumps performance under different conditions.
CLO7: Estimate and diagram pump performance
CLO8: Analyse hydraulic circuits and their components.
CLO9: Solve engineering problems for hydraulic machines.

	Course Contents:
1	Introduction to Hydraulic Machines
2	Pelton Turbines
3	Francis & Kaplan Turbines
4	Centrifugal Pumps
5	Cavitation in Pumps
6	Pumps Connection and selection
7	Introduction to fluid Power systems
8	Hydraulic Pumps (Positive displacement pumps)
9	Hydraulic Valves
10	Hydraulic Cylinders and Tanks

11	Examples of Hydraulic circuits

Textbook (s):

R.K. Rajput, “Fluid Mechanics and Hydraulic Machines”, S. Chand and Co., 6th, ed., 2014.

Esposito, A., "Fluid Power with Application”, Prentice Hall Inc., 6th ed., 2003.

Reference Book (s):

Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbo-machinery", Butterworth Heinemann, 5th ed., 2005.

Crowe, T.C., et al. "Engineering Fluid Mechanics", 8th ed., 2004.

Lewis, R. L., "Turbo-machinery Performance Analysis", Arnold, London, Butterworth-Heinemann, 2001.

Krivchenko, G. I. , “Hydraulic Machines: Turbines and Pumps", Lewis Publishers, 2nd ed., 1994.

Pinches, M. J. & Ashby, J. G., "Power Hydraulics", Prentice Hall, 1988.

Ernst W., "Oil Hydraulic Power and its industrial Applications", McGraw-Hill, 1960.

Mode of Evaluation:	**Percentage**
Assignments	7
Quizzes	7
Midterm exam -1	15
Midterm exam -2	15
Reports and Oral Exam	10
Final practical exam	6
Final exam	40

Course Title	System Dynamics and Mechanical Vibrations	**Coordinator**			
Course Code	424-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	321-ME-3 319-MATH- 3	**Level / Year**		**8/4**	
Mandatory course					

Course Objectives:
Developing course material according to the up-to-date advancements in the field and providing reference material.

Teaching Method:
Traditional classroom

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Define dynamical/vibrational characteristics of mechanical systems, degrees of freedom, and types of vibrations.
CLO2: Explain the principles of dynamics and vibrations of mechanical systems.
CLO3: Construct mechanical and mathematical models for the dynamic systems.
CLO4: Analyse the mechanical system's dynamical parameters

	Course Contents:
1	Introduction to dynamic systems, Modeling of mechanical systems
2	Methods of solving differential equations & Laplace transformations
3	State Space Representation & Transfer Function development of mechanical systems
4	Introduction to Vibrations of single degree of freedom SDOF systems + Free Un-damped/Damped Vibrations Analysis
5	Forced Vibrations for Damped/Un-damped SDOF systems
6	Frequency Response Transfer Function – Bode Plots
7	Vibrations of multi degree of freedom systems
8	Introduction to Continuous Systems
9	Vibration Absorption and Isolation

Textbook (s):
Mechanical Vibrations 5th Edition by Singiresu S. Rao.
Fundamentals of Applied Dynamics by Williams, James H., Jr.

Reference Book (s):
K. Ogata,"System Dynamics", Pearson Prentice Hall, 4th Edition.
Thomson, W.T. "Theory of Vibration with Applications", Prentice hall, 5th Edition
Ira Cochin,Harold J Plass, "Analysis and Design of dynamic System".Publisher: Harper & Row, Edition:1990.Ernst W., "Oil Hydraulic Power and its industrial Applications", McGraw-Hill, 1960.

Mode of Evaluation:	**Percentage**
Midterm Exam 1	15
Midterm Exam 2	15
Quizzes and Assignment	20
Lab	10
Final exam	40
Total	100

Course Title	Senior Design Project	**Coordinator**			
Course Code	573-ME-4	**Credit Hrs.**	**4**	**Contact Hrs.**	**4**
Prerequisites		**Level /Year**		9 & 10 / 5	
Mandatory course					

Course Objectives:
The graduation project is a project chosen by the student in the final year (in the ninth level). Students start to collect theoretical and practical information about the subject of the project and design and construct an experimental setup or develop a mathematical model. The second phase consists of performing experimental tests or verifying mathematical models using a computer simulation. Finally, the students prepare a final report, present it, and defend it in front of the Committee of project evaluation.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: State the basic science and mathematics, rules and steps of design, planning, and implementation of the engineering projects

CLO2: Relate societal, health, safety, legal, management, sustainability, and cultural issues involved in executing the engineering project

CLO3: Identifying the problem and formulating the procedure to solve the engineering problem

CLO4: Distributing the project work among the team and contributing individually

CLO5: Judge and understand contemporary issues involved in the project

CLO6: Assist on the internet and digital library to get more information and employ the blackboard facility to deal with each other and with the instructors

CLO7: Identifying, formulating, and finding various solution strategies by using appropriate resources
CLO8: Recognizing the techniques, skills, and modern engineering tools necessary for completing the project and justifying or evaluating the errors

CLO9: Appraise ideas and project outcomes using graphs, tables, and diagrams, and present and organize the thesis as per the standard format

CLO10: Organization of project content

CLO11:Judge and understand contemporary issues involved in the project

CLO12: Demonstrate and work cordially among the team to execute and complete the project.

CLO13: Demonstrate the proper use of English

CLO14: Show ability to communicate the methodology and solution

CLO15: Participate effectively and interact with audience

CLO16: Evaluate and integrate sustainability principles in the design, development, and execution of engineering projects, ensuring compliance with relevant environmental standards

CLO17: Analyse and incorporate cost-effectiveness and resource optimization in the implementation of engineering project

CLO 18: Analyse and articulate the impact of engineering decisions on global, economic, and social contexts by integrating ethical and stakeholder needs

CLO 19: Demonstrate the ability to make informed judgments in the design and implementation of engineering solutions

CLO 20: Design, develop, and test prototypes following relevant standards, and critically analyze results to refine engineering solutions

CLO 21: Inspect cultural, and social considerations into the design of engineering solutions and demonstrating awareness of diverse perspectives and societal impact

Course Contents:	

Textbook (s):

Reference Book (s):

Mode of Evaluation:

1.	Group Discussion, examination, speech	**10%**
2.	Internal presentations	**10%**

3.	Technical report (Interim)	**10%**
4.	First phase presentation	**10%**
5.	Second Phase internal presentation	10%
6.	Poster Presentation	10%
7.	Final Report	20%
8.	Final presentation	20%
	Total	100%

Course Title	Control Systems	**Coordinator**			
Course Code	511ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	424-ME-3	**Level / Year**		9/5	
Mandatory course					

Course Objectives:
The course objective is to enable the students to understand principles of control systems such as classifications of control systems, characteristic of feedback control systems, modelling of mechanical, electrical, electro-mechanical and hydraulic systems, block diagrams reduction. In addition to that, to analyze the performance of the first and second order systems and stability concepts.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Define in-depth integrated body of knowledge and comprehension of the underlying theories, principles, and concepts in automatic control.
CLO2: Apply integrated theories, principles, and concepts in various contexts, related to control systems, profession, or field of work
CLO3: Evaluate and collaborate responsibly and constructively in the practical and experimental work

Course Contents:	
1	Introduction to control systems and Laplace transforms.
2	Theory and modeling of linear mechanical systems: lumped parameter models of mechanical, electrical systems and Electromechanical systems; interconnection laws.
3	Actuators and sensors. Linear systems theory: linear algebra.
4	Block diagrams.
5	Time response, poles and zeros.
6	Time response solutions via analytical and numerical techniques.
7	Stability and Feedback systems control.
8	Stability of control systems: Routh–Hurwitz criterion
9	Controllers.
10	PID compensation; steady-state characteristics.
11	Root-locus and Frequency domain method.
12	Bode plots and Nyquist stability.

Textbook (s):

1. An and Kumar. " Control Systems" 2th Ed , PHI Learning Private Limited, Delhi, 2017. ISBN: 9788120349391.
2. Farid Golnaraghi, Benjamin C. Kuo, “Automatic Control Systems”, 10th d,McGraw Hill , Inc, 2017. ISBN:9781259643842.

Reference Book (s):

Nagoor, K., "Control System Engineering " 2st Ed., Rba Publications, 2013.ISBN: 9780000326065

Mode of Evaluation:

Mid-Term Tests (Not less than two Exams)…..……..…..(30 %)
Quizzes, Assignments, and Discussion Boards ……..…….. ..(20 %)
Lab reports ……..……..……... (10%)
Final Exam. ……..……..……. …….. (40 %)

Course Title	Engineering Entrepreneurship	**Coordinator**			
Course Code	511-GE-2	**Credit Hrs.**	**2**	**Contact Hrs.**	**2**
Prerequisites	NA	**Level / Year**		**9/4**	
Mandatory course					

Course Objectives:
This course aims to provide the background necessary to understand the entrepreneurial approach to business and the tools required to function effectively in the competitive entrepreneurial environment. At the end of this course, the students should be able to:
Explain and analyze the entrepreneurial process from generating creative ideas to exploring feasibility to creating an enterprise for implementing the ideas.
Experience the dynamics of participating on a business team and the power inherent in a team relative to individual effort.
Create and present a business plan for a technology idea.
Provide the background, tools, and life skills to participate in the entrepreneurial process within a large company, in a new venture, or as an investor.

Teaching Method:
Traditional classroom

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Apply the principles of entrepreneurship
CLO2: Apply the theories of entrepreneurship to launch a venture
CLO3: Interpret real-life situations for setting up an enterprise
CLO4: Practice Motivational Theories
CLO5: Analyse entrepreneurship as a career option
CLO6: Use the E-resources for Entrepreneurship
CLO7: Outline Business Ethics and values

	Course Contents:
1	Introduction to the course 511GE-3
2	Introduction to entrepreneurship, entrepreneur, importance
3	Creativity and innovation
4	Need for innovation and value addition
5	Entrepreneurial values and attitude
6	Motivation and achievement
7	Entrepreneurial opportunities
8	Setting up and enterprise
9	Resource mobilization
10	MSME and entrepreneurial ecosystem
11	Business plan and strategies
12	Business incubation

13	Launching, growing, and ending the new venture
14	Revision

Textbook (s):

Entrepreneurship for Engineers, Kenji Uchino, CRC Press-Taylor & Francis, International Standard Book Number: 978-1-4398-0063-8 (Paperback).

Entrepreneurship, Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Edition9, McGraw-Hill, 2009

The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Steve Blank and Bob Dorf, K&S Ranch Publishers, 2012, ISBN-13: 978-0-9849993-0-9.

Reference Book (s):

New Venture Creation: Entrepreneurship for the 21st Century, Jeffry A. Timmons, Stephen Spinelli Edition10, McGraw-Hill/Irwin, 2016

Entrepreneurship for Everyone: A Student Textbook, Robert Mellor, SAGE, 2008

What Every Engineer Should Know About Starting a High-Tech Business Venture,Eric Koester, CRC Press, 2009

An Introduction to Entrepreneurship, Eamonn Butler, Institute of Economic Affairs, 2020

Mode of Evaluation:	**Percentage**
Mini project [oral presentation]	5
Assignments/Quizzes/Conceptual Tests	20
Mid Examination [Written test]	30
Group Discussion	5
Final Examination	40

Course Title	Internal Combustion Engines	**Coordinator**			
Course Code	531-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	413-ME-3	**Level /Year**		9-10/5	
Mandatory course					

Course Objectives:
To enable students to understand, define, classify, design, and analyze different types of internal combustion engines.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Discuss the working of an IC engine
CLO2: Distinguish between normal and abnormal combustion
CLO3: Analyze engine performance parameters
CLO4: Interpret the basic principles of operation IC engine and related performance parameters

Course Contents:	
1	Introduction, Engine Types
2	Engine Design and Operating Parameters
3	Thermal cycles
4	Fuel and combustion
5	Emission control devices Phenomena
6	I.C.E. fuel systems, carburetion, fuel injection
7	Ignition systems
8	Engine performance
9	Supercharging and its effect on engine performance

Textbook (s):

1. Heywood, J.B, "Internal Combustion Engine Fundamentals",McGraw-Hill, latest edition.
2. Willard W. Pukabek, "Engineering Fundamentals of the InternalCombustion Engines", Prentice Hall, 2 ed., 2003.

Reference Book (s):

Mode of Evaluation:

1.	Quizzes– Mini Projects	10%
2.	Assignments	10%
3.	Midterm Exam I and II	30%
4.	Lab	10%
5.	Final exam	40%
	Total	100%

Course Title	Energy Conversion	**Coordinator**			
Course Code	532-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**3**
Prerequisites	422-ME-3	**Level /Year**		9-10/5	
Mandatory course					

Course Objectives:
This course will introduce the student to the basic language and concepts of energy, energy conversion and energy storage. Current and emerging technologies for conversion of thermal, mechanical, chemical, nuclear, solar and electrical energy will be discussed along with an introduction to tools that may be used for comparing competing energy conversion technologies.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:

CLO1: Analyse the advantages and limitations of a variety of energy conversion systems
CLO2: Compare competing energy conversion technologies on an economic and efficiency basis
CLO3: Construct multidisciplinary computational performance models of a variety of energy conversion system
CLO4: Perform discussions with colleagues and with teachers to choose and share the appropriate ideas.

Course Contents:	
1	Energy, Growth Rate & Energy Economics · energy, energy classification, units energy conversion, conversion efficiency · energy information and perspectives · growth rates, peak oil
2	Thermal-to-Mechanical Conversion · early engines & efficiency · Thermodynamics & power cycles & efficiency · Rankine Cycle · Brayton Cycle
3	Chemical-to-Thermal Conversion · fuels: coal, petroleum, gas · principles of combustion
4	Nuclear-to-Thermal Conversion · principles of nuclear energy · pressurized water reactors · boiling water reactors · boiling water, graphite-moderated reactors Gen-IV reactors
5	Electromagnetic-to-Electrical Conversion · principles of photovoltaic
6	Mechanical-to-Mechanical Conversion · principles of wind energy
7	Chemical-to-Electrical Conversion · principles of fuel cells
8	Introduction to Energy Storagehydrogen · flow batteries · compressed gas, flywheel

Textbook (s):

1. Fundamentals of Nuclear Science and Engineering, 2nd ed., J. K. Shultis and R. E. Faw, CRC Press, ISBN978-1-4200-5135-3 (2008).

2. Principles of Energy Conversion, 2nd ed., A. W. Culp, Jr., McGraw-Hill, ISBN 0-07 014892-9 (1991).
3. Power Plant Technology, M. M. El-Wakil, McGraw-Hill Book Company, ISBN 0-07-019288-X (1984) any recent Engineering Thermodynamics textbook
4. Energy Systems Engineering - Evaluation and Implementation, F. M. Vanek & L. D. Albright, McGraw-Hill, Inc., ISBN 978-0-07-149593-6 (2008).
5. Solar Engineering of Thermal Processes, 3rd ed., J. A. Duffie and W. A. Beckman, John Wiley & Sons (2006).

Reference Book (s):

Mode of Evaluation:

Midterm Exam I and II……30%
Assignments, Projects, Presentations……..20%
Quizzes, Take home exams……. 10%
Final exam……. 40%

Course Title	Power Plants	**Coordinator**			
Course Code	533-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	413ME-3	**Level /Year**		9-10/5	
Elective course					

Course Objectives:
The course aims to provide the student with the basic concepts required to understanding and solving the power plants and desalination problems applied on engineering. Defining the main principles of theoretical and practical information for different power plants. Acquiring some skills of designing steam power plants, gas turbine power plants, and combined cycle power plant.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:

CLO1: Define the main principles Steam Power plants.
CLO2: Analyze the various technological applications of desalination plants and selecting the appropriate desalination technology.
CLO3: Compare between the different types of power plants and differentiate the most suitable to provide the energy and the least polluted the environment.
CLO4: Show the Work independently and as part of a team.

Course Contents:	
1	Introduction
2	Ideal and Actual Rankine Cycle (vapor power plant)
3	Alternatives to Improve the Performance on a Rankine Cycle (i.e., Supercritical, Superheat, Reheat, and Regeneration)
4	Ideal and Actual Brayton Cycle (gas-turbine power plant) & Midterm-1
5	Alternatives to Improve the Performance on a Brayton Cycle (i.e., Regenerative Gas Turbine, Reheat, and Intercooling
6	Combined Gas Turbine-Vapor Power Plants
7	Cogeneration Systems and Integrated Gasification Combined-Cycle (IGCC) Power Plant & Midterm-2
8	Desalination Plants

Textbook (s):

1. Moran et. al., "Fundamentals ofEngineeringThermodynamics", United Kingdom, Wiley, 2020
2. El-Dessouky, H.T. and Ettouney, H.M., "Fundamentals of SaltWater Desalination", Elsevier Science, 2002.

Reference Book (s):

1. E l-Wakil, M. M., "Power Plant Technology", McGraw Hill, New York, 2002.
2. Raja, A.K., "Power Plant Engineering", New age international ltd, 2006.
3. Gill, A.B., "Power Plant Performance", Butterworth-Heinemann , 1404 AH.

4. Skrrotizki, B.G.A &Vopat, W.A, “Power Station Engineering and Economy”, Mc-Graw Hill, New York, 1972.
5. Howe, E.D., “Fundamentals of Water Desalination”, M. Dekker Publisher, 1974.

Mode of Evaluation:

Midterm Exam 1	15%
Midterm Exam 2	15%
Quizzes and Assignment	5%
Homework	5%
Semester project	15%
Tutorial Sheet	5%
Final exam	40%

Course Title	Energy Efficient Buildings	**Coordinator**			
Course Code	541-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**3**
Prerequisites	413ME-3	**Level /Year**		9-10/5	
Elective Course					

Course Objectives:

Upon completing this course, it is expected that the students will be able to:

(i) Estimate the optimum cost of energy consumption.
(ii) Monitoring the energy consumption.
(iii) Saving energy in refrigeration, air- conditioning and lighting processes.
(v) Prediction of thermal loads and correct the power factor.
(vi) Estimate the economic loading and operation for generation units.
(vii) Use energy saving policies and use high economic equipment's and improve heat transfer processes.

Teaching Method:

Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:

After the completion of this course, it is expected that the student will be able to:

CLO1: Outline the fundamentals of energy efficiency in buildings.

CLO2: Identify energy saving opportunities based on a cost-benefit analysis.

CLO3: Discuss the contribution of the building envelope to the energy system.

CLO4: Analyse the impact of maintenance measures on savings related to the systems required to heat, cool and electrically energize various features in a building.

Course Contents:	
1	Day lighting, building topology comparison.
2	Energy efficient buildings and the role they play in our efforts to address climate change.
3	The optimum cost of energy consumption and building envelope design.
4	The energy consumption in refrigeration, air- conditioning and lighting processes.
5	Refrigeration systems with working gaseous fluids (The air- standard refrigeration).
6	Thermal loads and corrects the power factor.
7	The economic loading and operation for generation units.
8	Energy saving policies and use high economic equipment's and improve heat transfer processes
9	Chemical reactions (Fuels and combustion and their applications. Theoretical and actual combustion processes. Enthalpy of formation and enthalpy of combustion. Steady-flow and closed reacting systems. First law analysis of reacting systems. Adiabatic flame temperature)

10	Zero energy homes in hot arid regions, life- cycle considerations and energy efficiency analysis to managing energy demand through equipment selection.

Textbook (s):

1. Desideri, Umberto, and Francesco Asdrubali, eds. Handbook of energy efficiency in buildings: a life cycle approach. Butterworth-Heinemann, 2018.
2. Jayamaha L. Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance: Green Strategies for Operation and Maintenance. McGraw Hill Professional; 2006 Nov 20.

Reference Book (s):

Mode of Evaluation:

1.	Midterm Exam 1	15%
2.	Midterm Exam 2	15%
3.	Quizzes and	10%
4.	Assignment	20%
5.	Final exam	40%

Course Title	Desalination	**Coordinator**			
Course Code	542-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**3**
Prerequisites	422-ME-3	**Level /Year**		9-10/5	
Elective Course					

Course Objectives:

- To provide students with the basic principles required for understanding different desalination methods
- To provide students with insight into the nature of desalination.
- To help students understanding fouling, scaling, and pretreatment
- To help students develop the ability to calculate permeate flow rate of RO systems and the total productivity of the other systems.

Teaching Method:

Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:

After the completion of this course, it is expected that the student will be able to:

CLO1: Outline the basics, theory, and physical concepts of water treatments.
CLO2: List the different configurations of thermal desalination Plants.
CLO3: Identify the different types of desalination plants.
CLO4: Differentiate between the different desalination plants.
CLO 5: Design different components of the desalination plants.
CLO 6: Estimate the cost of a cubic meter of desalinated water.
CLO 7: Plan in-class discussions with colleagues and with teachers.
CLO 8: Co-operate in a team to conduct experiments in desalination.

Course Contents:	
1	Concepts in thermodynamics; Water treatments; Fouling andscaling on tubes; fouling removal
2	Thermal desalination: Multistage evaporation systems (MES); Multistage Flash systems (MSF); Vapor compression desalination, systems(VCD); Solar desalination systems; co-generation power systems.
3	Reverse osmosis systems: Types of membranes; membrane arrangements; Energy recovery; back washing; membrane fouling; Ultra and nano-filtration.
4	Project: Analysis of Desalination Plant

Textbook (s):

1. El-Dessouky, H.T. and Ettouney, H.M., "Fundamentals of Salt Water Desalination", Elsevier Science, 2002, ISBN 978-0-444-50810-2

Reference Book (s):

1. Reverse Osmosis; A Practical Guide for Industrial Users - by Wes Byrne 1st Edition
2. Handbook of Desalination and Water Purification – Arshad Hasan Khan and Noam Lior by Elsevier
3. Hisham T. El-Dessouky and Hisham M. Ettouney, Fundamentals of Salt WaterDesalination, Elsevier Science B.V., 1st , 2002
4. Desalination Processes and Multistage Flash Distillation Practice 1986 Khan A.K

Mode of Evaluation:

1.	Midterm Exam 1	15%
2.	Midterm Exam 2	15%
3.	Quizzes and	10%
4.	Assignment	20%
5.	Final exam	40%

Course Title	Refrigeration and air Conditioning	**Coordinator**			
Course Code	543-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	413-ME-3	**Level /Year**		9-10/5	
Mandatory course					

Course Objectives:
At the end of this course, the students should be able to:

- Predict the COP of refrigerators and heat pumps,
- Design of evaporators,
- Design of condensers,
- Select and sizing expansion devices,
- Estimating the cooling load, and
- Estimating the air-conditioning load.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:

CLO1: Apply and comprehend thermodynamics and heat transfer theories, principles, and concepts on refrigeration and air-conditioning systems.

CLO2: Identify different thermodynamic processes, materials, conventions to illustrate and design different refrigeration systems considering environmental, safety, and economic feasibility.

CLO3: Use knowledge on human comfort and adapt psychrometry processes and charts to solve various practical numerical problems and problems on estimation of the cooling and heating load with an introduction to formulation and design of air-conditioning systems to mee the specified needs.

CLO4: Demonstrate a practical awareness about the working and operational procedures of various compressors, evaporators, condensers, expansion valves, and different.

Course Contents:	
1. **Introduction**	Principles of refrigeration-- Carnot refrigeration cycle -- unit of refrigeration – – Unit of Refrigeration-capacity of refrigeration -- coefficient of performance-Heat engine-refrigerating machine-heat pump.
2. Refrigeration Systems	VapourCompression System – theoretical and practical cycles – system components – compressors – condensers – expansion devices – evaporators – refrigerants. Air refrigeration cycle, Vapour absorption and adsorption refrigeration system- Thermoelectric refrigeration system- Magnetic – Vortex and Pulse tube refrigeration systems.
3. Refrigerants	Desirable properties – Classification – Nomenclature –Testing for leakage-Environmental effects- ODP & GWP.
4. **Psychrometry**	Psychrometric processes – determination of condition of air entering conditioned space. Air conditioning systems – summer, winter and year-round-year air conditioning systems -- central and unitary systems.

5. **Human Comfort**	Requirement of air conditioning – human comfort –comfort chart and limitations – effective temperature – factors governing effective temperature – design considerations.
6. **Cooling and Heating load calculations**	Various heat sources contributing heat load – solar load -- equipment load -- infiltration air load -- duct heat gain -- fan load -- moisture gain through permeable walls and fresh air load, Introduction to design of air conditioning systems.
7. **Recent topics of interest**	Recent topics over and above the syllabus& Revision.

Textbook (s):

1. McQuiston, Parker, Spitler, "Heating Ventilation & Air Conditioning Analysis and Design", Wiley., 6th ed., 2016. ISBN: 978-1-119-62879-8
2. Refrigeration-and-air-conditioning-by-C-P-Arora, 2009, Tata McGraw-Hill, ISBN-13: 978-0-07-008390-5

Reference Book (s):

- Principles of Heating, Ventilating, and Air Conditioning: A Textbook With Design Data Based on the 2001 Ashrae Handbook-Fundamentals, Jr. Sauer, Harry J. , Ronald H. Howell, William J. Coad, ISBN-13: 978-1883413941
- Basic Refrigeration and Air conditioning by Ananthanarayana, 2013, ISBN-13 978-1259062704
- ASHRAE Hand book, Fundamentals, 2021
- Jones W.P., "Air conditioning engineering", 5th edition,Elsevier Butterworth-Heinemann, 2001

Mode of Evaluation:

Assignments/Mini project	5%
Quizzes and Homework	15%
Mid Examination	30 %
Laboratory	10%
Final exam	40 %

Course Title	Computer Aided Manufacturing	**Coordinator**			
Course Code	534-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	311-ME-3	**Level /Year**		9-10/5	
Mandatory course					

Course Objectives:

1. Recognize an engineering drawing of a complex part; and how you will be able to correctly program the part.
2. Train on CNC M/C (turning – Milling).
3. Understand the various elements of the robot system.
4. Identify the different types of robots and appreciate the differences between them.
5. Understand the various types of robot geometry available.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Define various elements of the robot's system.
CLO2: Assess NC part program for the given contour
CLO3: Interpret robot geometric transformations
CLO4: Demonstrate the CNC Turning and Milling independently and as part of a team.

Course Contents:	
1	Introduction to CNC machines
2	CNC Turning tools
3	CNC Turning Programming
4	Introduction to CNC Milling machines
5	CNC Milling machines tools
6	CNC Milling Programming
7	Introduction to CNC Drilling
8	Introduction to robot
9	Robot geometries and problems
10	Real time problems on Robot geometries
11	Robot classification, Introduction to Robot Kinematics and problems

Textbook (s):

1. Mikell P. Groover, "Automation,Production Systems, and Computer Integrated Manufacturing" 2014 5th Edition
2. James A. Rehg, Henry W. Kraebber, "Computer Integrated Manufacturing",Prentice Hall, 3rd ed., 2005.
3. Groover, Zimmen, "CAD/CAM Computer Aided Design &Manufacturing",Prentice Hall, 2002.

Reference Book (s):

1. James V. Valentino and Joseph G., “Introduction to Computer Numerical Control(CNC)”, Pentice-Hall, 2000.
2. Kunwoo, L. “Principles of CAD/CAM/CAE”, Prentice Hall, 1999.
3. Bedworth D., Henderson M. R. & Wolfe P. M. "Computer Integrated Manufacturing" McGraw – Hall, 1999.

Mode of Evaluation:

1.Quiz-1, Quiz-2 & Quiz-3	15%
2.Midterm-1 & Midterm-2	30%
3.Lab and Report	15%
4. Final Exam	40%

Course Title	Mechanical Behavior of Materials	**Coordinator**			
Course Code	535-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	211-ME-3	**Level /Year**		9-10/5	
Elective course					

Course Objectives:
The main aim of this course is to provide knowledge on the application of scientific principles to real-life situations, by using appropriate mechanical tests. The major objectives include:

1. To gain an understanding of the dislocation theory and plastic deformation in order to explain strengthening mechanisms in different materials, materials applications in elevated temperature, fundamental of fracture mechanics, microstructure aspects of fracture toughness, transition temperature, environment-assisted cracking, and fatigue crack propagation.

2. To acquire practical experience in the use of mechanical testing equipment and use of scanning electron microscopy for failure analysis.

3. To cultivate interest in understanding the properties of materials required for various real-life applications.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:

CLO1: Relate the principles of mathematics, chemistry, and physics in the mechanical behaviour of materials and structural design

CLO2: Calculate stress and strain in elastic and plastic deformation.

CLO3: Identify various strengthening mechanisms and its applications.

CLO4: Describe the effect of notches and environments on the material fracture.

CLO5: Demonstrate the application of UTM, Impact Testing, Creep testing, and Fatigue Testing in characterization of materials

CLO6: Illustrate various mechanical testing and its procedures

Course Contents:	
1	Engineering Materials
2	Structure and Deformation in Materials
3	Mechanical Testing: Tension Test and Other Basic Tests
4	Stress–Strain Relationships and Behavior
5	Complex and Principal States of Stress and Strain

6	Yielding and Fracture under Combined Stresses
7	Fundamental of fracture mechanics, microstructure aspects of fracture toughness, the transition temperature
8	Environment-assisted cracking, Stress corrosion cracking, hydrogen embrittlement
9	Fatigue of Materials: Introduction and Stress-Based Approach
10	Notch Sensitivity and Fatigue crack propagation
11	Plastic Deformation Behavior and Models for Material, Microstructural Aspects of Plasticity
12	Dislocation, Slips, Strengthening mechanisms.
13	Time-Dependent Behavior: Creep and Damping

Textbook (s):

1. George Ellwood Dieter, Mechanical Metallurgy, McGraw-Hill, 1988
2. Marc Meyers and Krishan Chawla (Eds.), Mechanical Behavior of Materials, Cambridge University Press, 2009
3. N. E. Dowling. Mechanical Behavior of Materials, 2nd ed. (Prentice Hall: Upper SaddleRiver, NJ) 1999
4. T. H. Courtney. Mechanical Behavior of Materials, 2nd ed. (McGraw Hill: Boston)2000

Reference Book (s):

1. D. G. Rethwisch and W. D. Callister Jr, Fundamentals of Materials Science andEngineering: An Integrated Approach, John Wiley & Sons, NY, 3rd Edition, 2012.
2. Joachim Roesler, Harald Harders, Martin Baeker, Mechanical Behaviour of Engineering Materials: Metals, Ceramics, Polymers, and Composites, Springer Science & Business Media, 2007
3. ASM Metals Handbook, Volume 11, Failure Analysis and Prevention, Metals Park, 1986.
4. R. W. Hertzberg. Deformation and Fracture Mechanics of Engineering Materials, 4th ed.(J. Wiley & Sons: New York) 1995.

Mode of Evaluation:

1. Midterm Exam 1 15%
2. Midterm Exam 2 15%
3. Quizzes and Assignment 20%
4. Lab 10%
5. Final exam 40%

<table>
<tr><td>1. Course Number</td><td>536-ME-3</td><td>Course Name</td><td>Composite Materials</td></tr>
<tr><td>2. Credit hours</td><td>3 L = 3</td><td>Contact hours</td><td>3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="3">10/5</td></tr>
<tr><td>3. Course Instructor</td><td colspan="3">Dr. Vineet Tirth
Office No. 1-2-085</td></tr>
<tr><td>Tutorial/Practical Instructor</td><td colspan="3">NA</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="3">Textbook:
Composite Materials: Processing, Applications, Characterizations / edited by Kamal K. Kar. ISBN:9783662495148.

a. Other supplemental materials:
1. Composite Materials, Chung, D.D.L. (2010) , Springer London
ISBN: 978-1-4471-2547-1, eBook ISBN: 978-1-84882-831-5
DOI: https://doi.org/10.1007/978-1-84882-831-5
2. Composite Materials: Properties as Influenced by Phase Geometry 2005th Edition
ISBN-10: 3540243852, ISBN-13: 978-3540243854</td></tr>
<tr><td>5. Specific course information</td><td colspan="3">a. Brief description of the content of the course (catalog description)
This course covers different topics in composite materials such as classification, applications, processing and fabrication of composites (metal-matrix, ceramic-matrix, reinforced plastics, honeycomb materials, forming structural shapes). Also, Microstructure and mechanical properties of some composite materials will be studied followed by strengthening mechanisms and failure analysis of these types of materials.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="3">211-ME-3 Materials Science</td></tr>
<tr><td>Co-requisites</td><td colspan="3">Nil</td></tr>
<tr><td>c. Required, Elective, or Selected elective</td><td>Required</td><td>Language of instruction</td><td>English</td></tr>
<tr><td></td><td></td><td>Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="3">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO 1 [PI 1.1] Describe basic classifications and applications of composite materials SO1, KLO1
CLO 2 [PI 2.6] State Design Considerations and Laminate structures SO2, KLO2
CLO 3 [PI 1.1] Summarize Processing and fabrication of composites SO1, KLO1
CLO 4 [PI 1.3] Apply Stress-strain characteristics of fiber-reinforced materials SO1, KLO1
CLO 5 [PI 1.3] Apply failure theories of fiber-reinforced materials [S3] (2)
CLO 6 [PI 4.1] Evaluate environmentally induced stresses in laminates. SO4, KLO5
CLO 7 [PI 5.1] Demonstrate various applications of Composite materials individually and as a group. SO5, KLO 7</td></tr>
</table>

b. Course Learning Outcomes (Mapped with MEP Rubrics, ABET SO, NCAAA KLO)

CLO#	MEP Rubrics: Performance Indicator	ABET SO#	NCAAA KLO#
CLO1	1.1	1	1
CLO2	2.6	2	2
CLO3	1.1	1	1
CLO4	1.3	1	1
CLO5	1.3	1	1
CLO6	4.1	4	5
CLO7	5.1	5	7

7. Brief list of topics to be covered

1. Introduction to composite materials.
2. Classifications, types and applications of composite materials.
3. Manufacturing techniques of composite materials.
4. Microstructure of composite materials.
5. Mechanical properties of composite materials.
6. Strengthening mechanisms of composite materials.
7. Failure mechanisms of composite materials.

8. Any other information

Course Assessment

Activity	**Assessment% (Marks)**
Mid Exams 1 and 2 (Mandatory)	40% (40 Marks)
Quizzes	10% (10 Marks)
Assignments	5% (5 Marks)
Presentation	5% (5 Marks)
Final Exam	40% (40 Marks)
Total	100% (100 Marks)

Course Title	Fundamentals of Heat Treatment	**Coordinator**			
Course Code	544-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**4**
Prerequisites	211-ME-3	**Level /Year**		9-10/5	
Elective Course					

Course Objectives:

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

1. Discuss the nature of metals and alloys.
2. Recite the principles of heat treatment of steels.
3. Explain the heat treatment processes for steels.
4. Assess the hardenability of metals and alloys.
5. Select the quenching media for each heat treatment cycle.
6. Explain the chemical heat treatment of steels.
7. Explain the proper heat treatment cycle for each metal and alloy.
8. Explain the surface hardening treatment for metals and alloys.
9. Explain the thermo-mechanical treatment for ferrous and non-ferrous alloys.
10. Discuss the different types of heat treatment furnaces used in treating metals and alloys.

Teaching Method:

Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:

After the completion of this course, it is expected that the student will be able to:

CLO1: Identify the nature of metals and alloys for heat treatment

CLO2: Examine the hardenability of metals and alloys and identify the chemical heat treatment of steel

CLO3: Illustrate the proper heat treatment cycle for each metal and alloy.

CLO4: Compare the thermo-mechanical treatment for ferrous and non-ferrous alloys

CLO 5: Interpret the theoretical facts and the experiment results

Course Contents:	
1	Introduction to heat treatment
2	Natural of metals and alloys
3	Principals of heat treatment of steels
4	Heat treatment processes for steels
5	Hardenability and quenching
6	Chemical heat treatment of steels.
7	Surface hardening
8	Thermo-mechanical treatment
9	Heat treatment furnaces and atmospheres

Textbook (s):

T.V. Raja, C.P. Sharma, and A. Sharma, Heat treatment: principles and techniques, PHI Learning Private, New Delhi, 2011 (or later).

Reference Book (s):

1. R.C. Sharma, Principles of heat treatment of steels, New age international (P) Limited, New Delhi, 2003, ISBN: 8122408699.
2. B. Zakharov, Heat treatment of metals, USSR, 2002.

Mode of Evaluation:

1.	Midterm Exam 1	15%
2.	Midterm Exam 2	15%
3.	Quizzes and Assignment	20%
4.	Laboratory	10%
5.	Final exam	40%

Course Title	Finite Element Analysis in Mechanical Design	**Coordinator**			
Course Code	545-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**5**
Prerequisites	419-MATH-3 421-ME-3	**Level /Year**		9-10/5	
Elective Course					

Course Objectives:

Upon completing this course, it is expected that the students will be able to:

- Describe the procedures of FEM to solve an engineering problem
- Apply the FEM to 1D – Structural, thermal and fluid problems
- Analyse Plane truss problems, using FEA software and manually.
- Formulate axisymmetric and dynamic problems

Teaching Method:

Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:

After the completion of this course, it is expected that the student will be able to:

CLO1: Outline the basics of Finite Element Method
CLO2: Formulate the given problem into finite element model
CLO3: Apply the mathematical tools to arrive at finite element formulation
CLO4: Apply FEA to solve structural, thermal and fluid flow problems

Course Contents:	
1	Introduction and Basic Concepts of FEA , Matrix Algebra
2	Analysis of trusses-Two dimensional truss element, Stresses, Strains and temperature changes.
3	Beam bending- Two node beam element, Calculation of stresses in beams.
4	Shape functions, Linear and non-linear 1-D elements
5	Two dimensional boundary value problems using triangular elements, Triangular element for general 2D BVP
6	Iso-parametric quadrilateral elements-Shape functions for rectangular elements, quadrilateral elements, Numerical integration for quadrilateral elements, Four node quadrilateral element for 2D BVP
7	Axisymmetric elasticity problems-Governing equations for axisymmetric elasticity, Axisymmetric linear triangular element..
8	Numerical integration for Quadrilateral elements and Triangular elements

Textbook (s):

1. Finite element analysis: theory and application with ANSYS, Saeed Moaveni, Pearson,
ISBN-13: 9780273774334
2. Applied Finite Element Analysis, LJ Segerlind. 2nd Edition Wiley (1991)
ISBN-13: 978-0471806622
ISBN-10: 0471806625

Reference Book (s):

1. An Introduction to Finite Element Method, J N Reddy, McGraw - Hill. Concepts and Applications of Finite Element Analysis, R D Cook, Wiley

Mode of Evaluation:

1.	Midterm Exam 1	15%
2.	Midterm Exam 2	15%
3.	Quizzes and Assignment	20%
4.	Laboratory	10%
5.	Final exam	40%

Course Title	Nano technology	**Coordinator**			
Course Code	546-ME-3	**Credit Hrs.**	**3**	**Contact Hrs.**	**3**
Prerequisites	211-ME-3	**Level /Year**		9-10/5	
Mandatory course					

Course Objectives:
This course aims to introduce students to micro and nano fabrications techniques especially focus on integrated circuits (IC) including photolithography, etching, LIGA, and other microscopic fabrications.

Teaching Method:
Lectures, Lab, Tutorial, Group discussion

Expected Learning Outcome:
After the completion of this course, it is expected that the student will be able to:
CLO1: Describe the principles of nanotechnology
CLO2: Apply the concept of surface energy, chemical potential and analyzing electrostatic stabilization
CLO 3: Identify various production techniques for nanostructures and their applications.
CLO 4: Examine various nanomaterials and compare them based on their properties.

Course Contents:	
1	Emergence and challenges of Nanotechnology
2	Physical Chemistry of solid surfaces
3	Development and application of Nano particles, nano wires, nano rods and thin films
4	Special Nano materials: carbon fullerenes and nanotubes, micro and mesoporous materials
5	Nano structures fabricated by Physical Techniques
6	Structural and Chemical Characterization and properties of nano materials (Use of XRD, SEM, TEM, AFM)
7	Application of Nano materials

Textbook (s):
1. Marc J. Madou, Fundamentals of Microfabrication: The Science of Miniaturization, Second Edition, CRC Press, 2018, ISBN: 1482274000, 9781482274004
2. Stephen A. Campbell,"he Science and Engineering of Microelectronic Fabrication (Oxford series in electrical and computer engineering)Edition-2, Oxford University Press, 2001, ISBN: 0195136055, 9780195136050

Reference Book (s):
- Julian Serda, Michael Quirk, " Semiconductor Manufacturing Technology, International Edition", Pearson Education, Limited, 2000, ISBN: 0131229370, 9780131229372
- Hans H. Gatzen, Volker Saile, Jürg Leuthold, “Micro and Nano Fabrication: Tools and Processes”, Springer, 2015, ISBN:3662443953, 9783662443958=

Mode of Evaluation: Mid-Term Tests (Not less than two Exams)…..……..…..(30 %) Quizzes, , …… ……..…….. ……...(10 %) Assignments……..……..……...(20%) Final Exam. …….…….……. …….. (40 %)