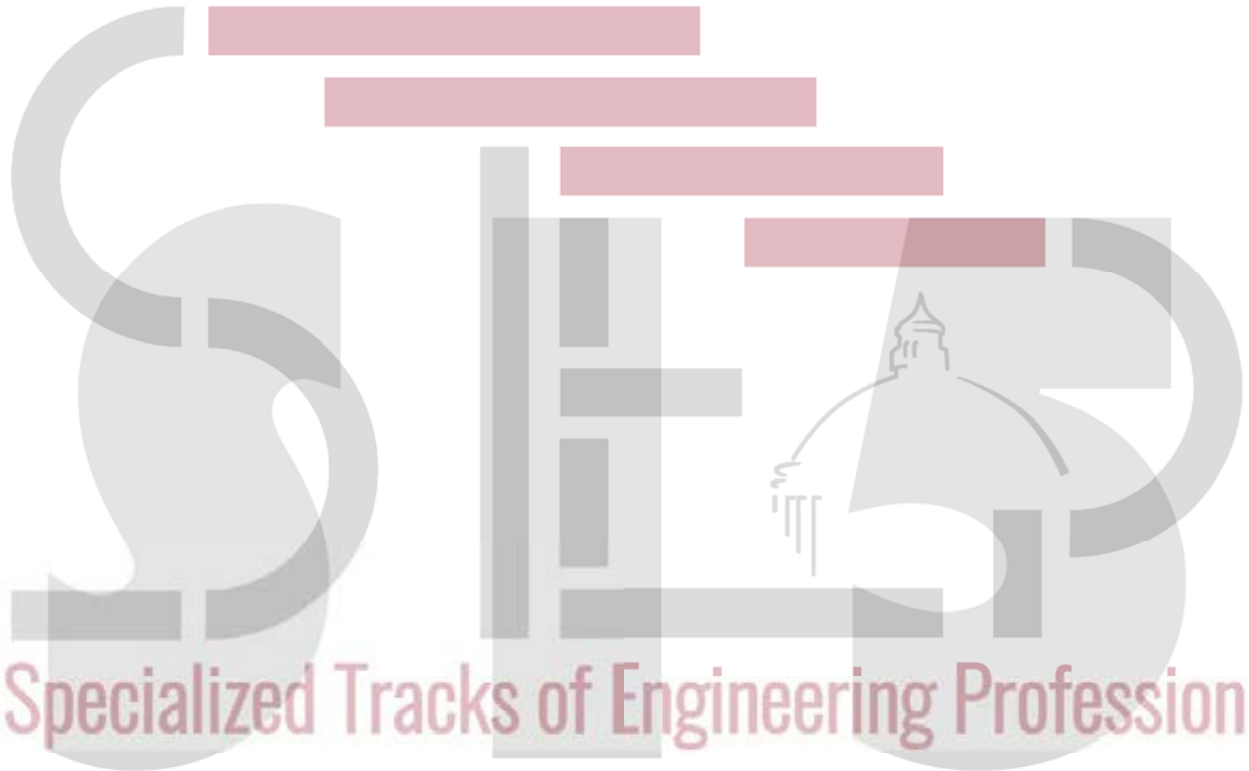

PART [C]: SPECIALIZED PROGRAMS

(15) SUSTAINABLE ENERGY ENGINEERING Program (SEE)

برنامج هندسة الطاقة المستدامة

(15) Sustainable Energy Engineering Program (SEE)

برنامج هندسة الطاقة المستدامة

VISION رؤية البرنامج

The vision of Sustainable Energy Engineering (SEE) Program is to provide a high-quality energy engineering education to graduate engineers who are innovative, entrepreneurial and successful in advanced fields of sustainable energy engineering to meet the ever-changing industrial demands and social needs.

MISSION رسالة البرنامج

The mission of the Sustainable Energy Engineering (SEE) Program is to develop scholar practitioners who would be the future leaders of their field driving profitability, avoiding unnecessary costs, achieving highest possible efficiencies through qualifying them with high skills based upon deep understanding of the physics and comprehending the human and economical dimensions. The program will provide the optimal learning environment with close exchange and continuous engagement with the ongoing mega projects taking place in the country to provide a generation of hands on engineers who are ready to embark into constructing activities once they graduate. The graduates would be of known attributes that are required by the business community in the field of Sustainable Energy Engineering (SEE).

GRADUATE ATTRIBUTES مواصفات الخريج

The SEE program has adopted the National Academic Reference Standards (NARS) for Engineering issued by the National Authority for Quality Assurance and Accreditation for Education (NAQAAE) as the program objects to ensure the satisfaction of the national quality assurance standards. The NARS 2018 for Engineering are broad statements that define the main characteristics and performance expected from all engineering students upon their graduation so that the graduate attributes of the SEE program can be achieved as follows, where the graduate must be able to:

BASIC Mechanical Engineering graduate must be able to:

1. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations.
2. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.
3. Select conventional mechanical equipment according to the required performance.
4. Adopt suitable national and international standards and codes; and integrate legal, economic and financial aspects to: design, build, operate, inspect and maintain mechanical equipment and systems.

In Addition to the above attributes for Mechanical Engineers; the Sustainable Energy Engineering Graduate must be able to:

1. Work with energy systems such as conventional energy generation systems, renewable and clean power generation systems, refrigeration, heating, ventilation, and air conditioning (HVAC) systems.

2. Cope with the state of art applications in the market nowadays such as green buildings and all types of renewable energies.

3. Perform an accurate performance analysis for the mentioned systems using mathematics, physical and engineering sciences.

4. Use different instruments appropriately and carryout experimental design, automatic data acquisition, data analysis, data reduction and interpretation, and data presentation, both orally and in the written form.

5. Use and/or develop computer software, necessary for the proper designs of high-performance systems.

6. Lead or supervise a group of designers or technicians and other work force.

PROGRAM BENCHMARK مرجعية البرنامج

NARS 2018	LEVEL A	LEVEL B	LEVEL C	LEVEL D
	Totally Adopted P.A11	Partially Adopted	See below	NA

LEVEL C:

C1. Design, install, operate and Specify Design energy generation equipment for conventional, new and renewable energy systems;
C2. Understand, design and apply the principles of fire safety and fire-fighting systems.
C3. Analyze experimental results and determine their accuracy and validity.
C4. Use computational tools and packages and write computer programs pertaining to mechanical power and sustainable energy engineering.
C5. Design, develop, or evaluate energy-related projects or programs to reduce energy costs or improve energy efficiency during the designing, building, or remodeling stages of construction.

SPECIALIZED COURSES CONTENTS توصيف المقررات

Code	Name	Credit Hours	Category	Pre-requisite
SEES280	Engineering Seminar	1	DR	30 CR.HRS. + AA APROVAL
SEES281	Industrial Training-1	1	FR	60 CR.HRS. + AA APROVAL
SEES381	Industrial Training-2	2	DR	SEES281 + AA APPROVAL
SEES481	Graduation Project-1	1	FR	110 CR.HRS.+ SOPHOMORE
SEES482	Graduation Project-2	3	DR	SEES481 + AA APROVAL
Total		2+6		

COURSES CONTENTS توصيف المقررات

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
Faculty Requirements										
SEES280	Engineering Seminar	1	1	0						1
	Pre-requisites: 30 CR.HRS. + AA APROVAL									
	Talks and presentations are invited from industrial establishments relevant to the program. The guest speaker should discuss the organization, management, and recent technologies implemented in his/her industrial establishment. Students exercise writing brief technical reports on the guest presentation and deliver their own presentation about the topic. The course is graded as Pass/Fail grade-system.									
SEES281	Industrial Training-1	1	0	0						0
	Pre-requisites: 60 CR.HRS. + AA APROVAL									
	Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a minimum period of three weeks. The program training advisor schedules at least one follows up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industria establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade-system.									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
SEES381	Industrial Training-2	2	0	0						0
	Pre-requisites: SEES281 + AA Approval									
	Training on industrial establishments relevant to the program. Training lasts for total of 180 hours, during a minimum period of six weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade-system.									
SEES481	Graduation Project-1	1	0	0	2					2
	Pre-requisites: 110 credits + SOPHOMORE									
	Students – in groups (or individually in some programs) - undertake a final project as part of the program. In GP1, students provide a clear identification of a real-life problem that represents an actual need for the industry or the community and reflects the mission and strategic objective of CUFE. Students are expected to survey the related literature, collect, and interpret market data, and proposed an approach for the solution, using the engineering knowledge and skills acquired. The course is graded as Pass/Fail based upon a report/oral presentation stating the expected cost and required material, tools, and facilities as well as a timed list of deliverables.									
SEES482	Graduation Project-2	3	1	0	2	2				5
	Pre-requisites: SEES481 + AA Approval									
	Graduation Project-2 is the second phase of the graduation project. The aim is to develop innovative solutions to problems encountered during the implementation process thus fulfilling the deliverables stated in Graduation Project-1. A dissertation on the project is submitted taking into consideration technical, economic, social, and environmental requirements while analysing the major results and presenting direct conclusions.									

PROGRAM REQUIREMENTS متطلبات البرنامج

Category		No. of courses	Course Credit Hour	Total Credit Hours
Discipline Requirements (DR)	core/ compulsory	18	3	54
		2	2	4
	Elective	2	3	6
Total DR courses		22		64
Program Requirement (PR)	core/ compulsory	8	3	24
		3	2	6
	Elective	3	3	9
		2	2	4
Total PR courses		16		43
Total Elective courses (DR & PR)		7		19

- **Discipline Requirements (DR) core/compulsory courses list**

Code	Name	Credit Hours	Pre-requiste
MDPS001	Fundamentals of Manufacturing Engineering	2	None
MTHS102	Linear Algebra and Multivariable Calculus	3	MTHS003
MTHS104	Differential Equations	3	MTHS003
EPES201	Electrical Engineering Fundamentals	3	PHYS002
MCNS101	Thermodynamics	3	PHYS001
MCNS326	Heat Transfer	3	MCNS101
MCNS327	Heat and Mass Transfer	3	MCNS326
MDPS132	Materials Science	3	None
MDPS261	Stress Analysis	3	EMCS002
MEPS209	Engineering Thermodynamics	3	MCNS101
MCNS202	Fluid Mechanics	3	MTHS002
MEPS224	Intermediate Fluid Mechanics	2	MCNS202
MEPS309	Thermal Design of Energy Facilities	3	MCNS202 + MCNS326
MEPS310	Mechanics of Machines and Vibration	3	MDPS261
MEPS231	Laboratory of Mechanical Engineering	3	MCNS202
MEPS436	Fundamentals of Turbomachinery	3	MCNS202
MEPS203	Fundamentals of Combustion Systems	3	MEPS209

Code	Name	Credit Hours	Pre-requiste
MEPS201	Internal Combustion Engines (Theory and Development)	3	MEPS209
MEPS306	Instrumentation and Computer Control (Application and Design)	3	EPES201
MTHS114	Numerical Analysis	3	MTHS102 + MTHS104
Total		**58**	

- **Discipline Requirements (DR) elective courses list**

Code	Name	Credit Hours	Pre-requiste
ELECTIVE (E-2) 2 courses (6 Credits)			
EPES303	Electric Drive Systems	3	EPES201
MDPS352	Machine Design	3	MDPS261
MDPS241	Manufacturing Processes I	3	PHYS001
MDPS217	Machine Drawing	3	INTS001
MDPS432	Pressure Vessels and Piping	3	85 credits + AA Approval
MEPS333	Automotive Systems	3	MEPS201
MEPS402	Sea Water Desalination	3	MCNS326
MEPS403	Heat Exchangers Design	3	MCNS326
EPES450	Programmable Logic Controllers	3	EPES303
MDPS381	Fundamentals of Industrial Engineering	3	NONE
MDPS382	Engineering Economy and Financial Management	3	E-A (GENS120)
MDPS383	Operations Research I	3	MTHS102
Total		**36**	

- **Program Requirements (PR) core/compulsory courses list**

Code	Name	Credit Hours	Pre-requiste
MEPS404	Nuclear Energy	3	MEPS209
MEPS305	Applied Control Technologies for Energy System	3	MTHS003 + MEPS224
MEPS320	Fundamentals and Applications of Solar Energy	3	MCNS326
MEPS415	Power Generation	3	85 credits + AA
MEPS316	Air and Water Pollution and Quality Monitoring	3	MCNS202 + MEPS203
MEPS420	Fundamentals of Energy in Buildings	2	MEPS421
MEPS421	Fundamentals of Refrigeration and Air Conditioning Design	3	MCNS326 + MEPS209
MEPS430	Wind Energy Systems Design	2	MEPS224
MEPS332	Laboratory of Energy Systems	2	MCNS326 + MEPS201
MEPS446	Applications of Turbomachinery	3	MEPS436 + 102 credits
MEPS472	Automatic Control	3	MEPS224
Total		**30**	

- **Program Requirements (PR) elective courses list**

Code	Name	Credit Hours	Pre-requiste
ELECTIVE (E-3) 3 courses (9 Credits)			
MEPS328	Fine Measurements and Laser Diagnostics in Energy System	3	MCNS101 + MCNS202
MEPS413	Industrial Process Heating and Cooling	3	MEPS320
MEPS422	Energy Auditing	3	MEPS421
MEPS425	Renewable Energy	3	85 credits
MEPS432	Design of Renewable Energy Ecuipment	3	MEPS320
MEPS444	Energy Efficiency	3	MEPS209 + MCNS327
MEPS475	Hydroelectric Power Plants	3	MEPS436 + MEPS224

Code	Name	Credit Hours	Pre-requiste
MEPS431	Sustainability and Design for Environment	3	60 Credits
MEPS438	Hydrogen technologies for a sustainable energy system	3	MEPS203
MEPS439	Fundamentals of Photovoltaics	3	MEPS209
ELECTIVE (E-4) 2 courses (4 Credits)			
MEPS407	Fire Extinguishing Systems	2	MEPS224 + MEPS203
MEPS411	Concentrated Solar Power (CSF)	2	MEPS320
MEPS412	Energy Storage	2	MEPS320
MEPS414	Advanced CFD	2	MEPS224
MEPS417	Pollution control equipment design	2	MCNS202 + MEPS203
MEPS418	PV Technology and its applications	2	MEPS320
MEPS419	Oil Hydraulics and Pneumatics	2	MEPS224
Total		**33**	

Proposed Study Plan - 8 semesters - Including Freshman Level

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	OffHr	Total
SEMESTER 1	PHYS001	Mechanical Properties of Matter and Thermodynamics	3	2		2	1				5
	MTHS002	Calculus I	3	2	2						4
	EMCS001	Engineering Mechanics - Dynamics	3	1	2		1				4
	CHES001	Chemistry for Engineers	2	1	2						3
	INTS001	Engineering Graphics	3	2				3			5
	INTS004	Information Technology	2	1			3				4
	GENS004	Proficiency and Capacity Building	1	1							1
	GENS001	Critical and Creative Thinking	2	2							2
		Sub-Total	**19**	**13**	**6**	**2**	**4**	**3**	**0**	**0**	**28**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 2	MTHS003	Calculus 2	3	2	2						4
	EMCS002	Engineering Mechanics - Statics	2	1	2						3
	PHYS002	Electricity and Magnetism	3	2		2	1				5
	MDPS001	Fundamentals of Manufacturing Engineering	2	1			3				4
	MTHS005	Introduction to Probability and Statistics	3	2	2						4
	MCNS101	Thermodynamics	3	2	2						4
	MDPS132	Materials Science	3	2	0	2	1				5
		Sub-Total	**19**	**12**	**8**	**4**	**5**	**0**	**0**	**0**	**29**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	Off Hr	Total
SEMESTER 3	MDPS261	Stress Analysis	3	2	2						4
	E-A (GENS110)	Elective E-A (Fundamental of Management, Risk and Environment)	2	2							2
	E-A (GENS005)	Elective E-A (Writing and Presentation Skills)	2	2							2
	EPES201	Electrical Engineering Fundamentals	3	2		3					5
	MCNS202	Fluid Mechanics	3	2	2						4
	MTHS104	Differential Equations	3	2	2						4
	MEPS209	Engineering Thermodynamics	3	2		3					5
		Sub-Total	**19**	**14**	**6**	**6**	**0**	**0**	**0**	**0**	**26**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 4	MEPS231	Laboratory of Mechanical Engineering	3	2			2				4
	MEPS224	Intermediate Fluid Mechanics	2	2		2					4
	MEPS201	Internal Combustion Engines (Theory and Development)	3	2		2	1				5
	GENS002	Societal Issues	2	2							2
	MCNS326	Heat Transfer	3	2	2						4
	MTHS102	Linear Algebra and Multivariable Calculus	3	2	2						4
	MEPS203	Fundamentals of Combustion Systems	3	2		2					4
		Sub-Total	**19**	**14**	**4**	**6**	**3**	**0**	**0**	**0**	**27**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	Off Hr	Total
SEMESTER 5	SEES280	Engineering Seminar	1	1							1
	E-2	ELECTIVE E-2	3	2		2	1				5
	MTHS114	Numerical Analysis	3	2	2						4
	MEPS306	Instrumentation and Computer Control (Application and Design)	3	2			2				4
	MEPS305	Applied Control Technologies for Energy System	3	2	2						4
	MCNS327	Heat and Mass Transfer	3	2		2	1				5
	MEPS310	Mechanics of Machines and Vibration	3	2		2	1				5
		Sub-Total	**19**	**13**	**4**	**6**	**5**	**0**	**0**	**0**	**28**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 6	E-A (GENS120)	Elective E-A (Fund. of Ecconomics and Accounting)	2	2							2
	MEPS316	Air and Water Pollution and Quality Monitoring	3	2	2						4
	MEPS332	Laboratory of Energy Systems	2	2			2				4
	MEPS309	Thermal Design of Energy Facilities	3	2		2					4
	E-3	ELECTIVE E-3	3	2	2						4
	E-2	ELECTIVE E-2	3	2		2	1				5
	MEPS320	Fundamentals and Applications of Solar Energy	3	2		2	1				5
		Sub-Total	**19**	**14**	**4**	**6**	**4**	**0**	**0**	**0**	**28**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	OffHr	Total
SEMESTER 7	MEPS436	Fundamentals of Turbomachinery	3	2	2						4
	GENSXXX	UR Elective Course	2	2							2
	MEPS421	Fundamentals of Refrigeration and Air Conditioning Design	3	2	2						4
	MEPS404	Nuclear Energy	3	2	2						4
	E-4	ELECTIVE E-4	2	2		2					4
	E-4	ELECTIVE E-4	2	2		2					4
	E-3	ELECTIVE E-3	3	2	2						4
	SEES481	Graduation Project - 1	1			2					2
		Sub-Total	**19**	**14**	**8**	**6**	**0**	**0**	**0**	**0**	**28**

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 8	MEPS430	Wind Energy Systems Design	2	2		2					4
	MEPS420	Fundamentals of Energy in Buildings	2	1	2						3
	MEPS415	Power Generation	3	2		2					4
	MEPS472	Automatic Control	3	2	2						4
	MEPS446	Applications of Turbomachinery	3	2	2						4
	E-3	ELECTIVE E-3	3	2	2						4
	SEES482	Graduation Project - 2	3	2		1	2				5
		Sub-Total	**19**	**14**	**6**	**6**	**2**				**28**

COURSES CONTENTS توصيف المقررات

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
Discipline Compulsory Courses										
MDPS001	Fundamentals of Manufacturing Engineering	2	1	0	3					4
	Pre-requisites: None									
	Engineering Materials - Elements of Manufacturing Processes - Casting and molding processes- metal forming processes - Shaping of plastic material - Joining processes - Metal cutting and finishing processes - Modern Manufacturing, additive manufacturing and 3D printing									
References	Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 7th Edition, Wiley, 2019.									
MTHS102	Linear Algebra and Multivariable Calculus	3	2	2	0					4
	Pre-requisites: MTHS003									
	Solving Linear Systems, Vector Spaces and Subspaces, Inner Product Spaces and Orthonormal Bases, The Eigenvalue Problem; Diagonalization of Matrices, Computing Functions of Matrices. Functions of Several Variables, The Gradient of a Scalar Function and its Applications, Vector Fields, Curl and Divergence, Double and Triple Integrals with Applications, Line and Surface Integrals with Applications.									
References	1.Calculus Early Transcendentals", by James Stewart, 8th edition, 2015, Cengage Learning. 2.Elementary Linear Algebra with Applications" by B. Kolman and D. Hill, 2013, Pearson international edition.									
MTHS104	Differential Equations	3	2	2	0					4
	Pre-requisites: MTHS003									
	First-order differential equations, separable, exact, linear, homogeneous and Bernoulli equations; modeling with first order differential equations; higher-order differential equations; method of undetermined coefficients; variation of parameters; modeling with higher order differential equations; series solutions; Laplace transform; properties and applications, shifting theorems, convolution theorem; solutions of differential equations using Laplace transform; Fourier series; Fourier transform.									
References	1. Fundamental of differential equations, Nagle, Saff and Snider, Pearson, education limited, 2014, eighth edition . 2. A first course in differential equations, D. Zill, Brooks and Cole, ninth edition, 2014									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
EPES201	Electrical Engineering Fundamentals	3	2	0	3	0	0	0		5
	Pre-requisites: PHYS002									
	Analysis of DC and AC circuits, branch currents and node voltages. Transient analysis. Single-phase transformers and circuits thereof. Basic DC motors: series shunt and compound. Induction motors. Predicting motor performance. Logic gates, circuit design with logic gates.									
References	A. R. Hambley, Electrical Engineering: Principles and Applications, 7th ed. Pearson, 2018.									
MCNS101	Thermodynamics	3	2	2	0	0	0	0		4
	Pre-requisites: PHYS001									
	Basic concepts-pure substances - First law of thermodynamics and applications – second law of thermodynamics and corollaries – entropy. May include a visit to a power plant.									
References	1. Thermodynamics: An Engineering Approach [8 ed.] by Yunus Cengel, Michael Boles									
MCNS326	Heat Transfer	3	2	2	0	0	0	0		4
	Pre-requisites: MCNS101									
	Conduction: General equation of conduction, one dimensional steady-state conduction, steady-state conduction with internal heat generation, steady conduction with variable thermal conductivity, fins and extended surfaces, unsteady conduction. Convection: fundamentals of convection, dimensionless groups, natural and forced convection, use of empirical correlations. Radiation: Fundamentals of heat transfer by radiation. Case studies and computer applications.									
References	Foundations of Heat Transfer, 6th Edition International Student Version by Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine									
MCNS327	Heat and MassTransfer	3	2	0	2	1	0	0		5
	Pre-requisites: MCNS326.									
	Fundamental Concepts of Film and Turbulent Condensation - Fundamental Concepts of Film and Turbulent Condensation - Characteristics of Flow Boiling - Types of Heat Exchangers - Logarithmic Mean Temperature Difference Method - Effectiveness- NTU Method - Fundamentals of Mass Transfer - Analogy between Heat and Mass Transfer - Diffusion Mass Transfer and Binary Mixtures - Evaporation in a Column - Convective Mass Transfer - Cooling Towers - Solar Collectors & HRSG)									
References	1.Holman, J.P., "Heat Transfer", McGraw Hill Inc., 2009. 2.Incropera, F.P. and De Witt, D.P., "Fundamentals of Heat and Mass Transfer", eighth Edition, John Wiley & Sons, 2020.									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MDPS132	Material Science	3	2	0	2	1	0	0		5
	Pre-requisites: None									
	Nature and properties of materials : Crystal structures and lattices, crystal imperfections, slip and dislocations, plastic deformation, phase diagrams, binary phase equilibrium characteristics of alloy solidification anc structure of metals and alloys, Iron carbon diagram, various types of bonds, Hot and cold working of metals, recovery, re-crystalization and grain growth. Metallography: Study of microstructure									
References	William D. Callister Jr., David G. Rethwisch, Materials Science and Engineering: An Introduction, 10th Edition, Wiley, 2018.									
MDPS261	Stress Analysis	3	2	2	0	0	0	0		4
	Pre-requisites: EMCS002									
	Equilibrium, continuity, material mechanical behavior. Normal force, shearing force, bending and twisting moment diagrams. Stresses in simply loaded elastic bars: axial loading, bending and torsion, deformation, stiffness, strain energy. Stresses in elastic and elasto-plastic bars, residual stresses. Combined loading, eccentric normal load, oblique bending, combined bending and torsion.									
References	Structural and Stress Analysis, Author(s): T.H.G. Megson									
MEPS209	Engineering Thermodynamics	3	2	2	0	1	0	0		5
	Pre-requisites: MCNS101.									
	Vapor Power Cycles – Gas Power Cycles – Refrigeration Cycles – Exergy – Non- reacting Gas Mixtures – Psychometry – Combustion chemical reactions – First Law Analysis of Combustion Processes									
References	Borgnakke, C. and Sonntag, R.E. ©2014 "Fundamentals of Thermodynamics", 8th Edition, John Wiley & Sons, Singapore Pte. Ltd.									
MCNS202	Fluid Mechanics	3	2	2	0					4
	Pre-requisites: MTHS002									
	Fluid kinematics. flow types. Integral analysis of flow: Continuity, Linear momentum, Angular momentum and Energy equations, Applications. Similitude and dimensional analysis and modeling, Viscous flow in pipes and ducts. Flow measurement. General applications. Course project computer oriented.									
References	1. Bruce R. Munson, Donald F. young, and Theodore H. Okiishi, "Fundamentals of fluid mechanics" , John Wiley & Sons. 2. Yunus A. Cengel and John M. Cimbala, "Fluid Mechanics - Fundamentals and Applications" McGraw Hill.									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS224	Intermediate Fluid Mechanics	3	2	0	3	0	0	0		5
	Pre-requisites: MCNS202									
	Introduction to the Navier-Stokes equations; Incompressible viscous and inviscid potential flows; Laminar and turbulent boundary layers: Growth, shear relations and total drag; Flow around a body: Lift, drag, and separation; 1-D compressible flow and shock waves; Water Hammer; Open-channel flow: Specific energy critical depth, gradually-varying flow and hydraulic jump.									
References	• Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Wade W. Huebsch-Fundamentals of Fluid Mechanics-Wiley (2009) • Frank M White - Fluid mechanics (2003, McGraw-Hill) • Fox - Introduction to Fluid Mechanics 8th Edition									
MEPS309	Thermal Design of Energy Facilities	3	2	0	2	1	0	0		5
	Pre-requisites: MCNS202, MCNS326									
	- Introduction and overview - Energy system components and configuration - Thermal performance evaluation - Physical modeling of transport qualities and governing equations - Modeling methods and algorithms - Thermal design of: • Heat exchangers • Compressors • Turbines • Pumps • Facilities phase change Computer-aided design software with application of energy facilities									
References	1- Design of thermal energy systems, Pradip Majumdar 2-Thermal Energy Systems _ Design and Analysis, Steven G. Penoncello,2nd ed (2019)									
MEPS310	Mechanics of Machines and Vibration	3	2	0	2	1	0	0		5
	Pre-requisites: MDPS261									
	Kinematic fundamentals: geometry of motion, machine components; Dynamics basic concepts: work and energy , balancing of Machines; Introduction and basic concepts of mechanical vibrations : sources and causes of vibration, basic theoretical concepts of acoustical vibrating systems in thermo-fluid systems; plane linear wave propagation and transmission, fluid-structure interaction.									
References	R. C. Hibbeler, "Mechanics of Materials", Tenth Edition in SI Units, Pearson, 2018.									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS231	Laboratory of Mechanical Engineering	3	2	0	0	3	0	0		5
	Pre-requisites: MCNS202									
	Pressure measurements – manometers – Pitot tube – pressure gauges – flow meters – Venturimeter – Temperature measurements – Thermometers – Thermocouples – Flux-meters – Viscometers – Heat release rate measurements – conductivity measurements – forced convection measurements – radiation measurements – Measurements of flow around immersed bodies.									
References	1. Babak, V. P., Babak, S. V., Eremenko, V. S., Kuts, Y. V., Myslovych, M. V., Scherbak, L. M., & Zaporozhets, A. O. (2021). Models and Measures in Measurements and Monitoring. Springer. 2. Figliola, R. S., & Beasley, D. E. (2020). Theory and design for mechanical measurem John Wiley & Sons. 3. Cataldo, A., Giaquinto, N., De Benedetto, E., Masciullo, A., Cannazza, G., Lorenzo, I. & Gaetani, F. (2020). Basic Theory and Laboratory Experiments in Measurement and Instrumentation: A Practice-Orientec Guide. Springer. 4. Francis, S. T., & Morse, I. E. (2018). Measurement and instrumentation in engineering: principles and basic laboratory experiments. CRC Press.									
MEPS436	Fundamentals of Turbomachinery	3	2	2	0	0	0	0		4
	Pre-requisites: MCNS202									
	Basic concepts and laws of fluid mechanics – Similarity of fluid machines – One-dimensional flow in turbomachines: Euler equation, The Degree of reaction & Stage and components efficiency – Two-dimensional flow through cascade of blades: Blade cascade terminology, Energy transfer in terms of lift and drag & Analytical methods for solution of two-dimensional cascade flow – Three-dimensional flow in axial turbomachines: Radial equilibrium theory, Compressor and pump design & Turbine design including free vortex design, forced vortex design and general vortex design.									
References	Fluid Mechanics and Thermodynamics of Turbomachiner-7- Edition, by S. L. Dixon, 2014									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS203	Fundamentals of Combustion Systems	3	2	0	2	1	0	0		5
	Pre-requisites: MEPS209									
	Fuel types and properties; chemically reacting systems; mass conservation; chemical kinetics; chemical equilibrium and dissociation; introduction to flame types and theory; burner types and design; combustion system efficiency and tune-up; stability and elements of combustion control, Premixed and Non-Premixed Combustion, Laminar and Turbulent Combustion.									
References	1. Combustion, Fifth Edition by Irvin Glassman, Richard A. Yetter, Nick G. Glumac 2. Combustion engineering by Song-Charng Kong; Kenneth M. Bryden; Kenneth W. Ragland									
MEPS201	Internal Combustion Engines (Theory and Development)	3	2	0	2	1	0	0		5
	Pre-requisites: MEPS209									
	Gases Flow and Exchange in Internal Combustion Engines - Flow Inside Combustion Chamber - Charge Movement Inside the Cylinder - Modeling of Combustion and Flow inside Combustion Chamber - Adjusting and Controlling Engine Performance -Increasing Engine Power (Supercharging, Fuel Injection, Fuel/Air Mixture Control, etc..) - Examples for Advanced Technologies in Internal Combustion Engines (Gas Engine, Fuel Cells, Electric Cells, etc.).									
References	Internal Combustion Engines Fundamentals by Heywood J.B.									
MEPS306	Instrumentation and Computer Control (Application and Design)	3	2	2	0	0	0	0		4
	Pre-requisites: EPES201									
	- Types of applications of measurement instrumentation - Generalized configuration of measuring and control systems - Generalized performance characteristics - Measuring devices for engineering quantities and parameters - Manipulation transmission and recording of data - Data acquisition and processing systems - Computer-aided experimentations Practicing and laboratory sessions									
References	1. Adams, M. D. (2020). Signals and Systems (Edition 3.0). Michael Adams. 2. Cataldo, A., Giaquinto, N., De Benedetto, E., Masciullo, A., Cannazza, G., Lorenzo, I. & Gaetani, F. (2020). Basic Theory and Laboratory Experiments in Measurement and Instrumentation: A Practice-Oriented Guide. Springer. 3. Eren, H. (2018). Wireless sensors and instruments: networks, design, and applications. CRC Press.									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MTHS114	Numerical Analysis	3	2	2	0	0	0	0		4
	Pre-requisites: MTHS102, MTHS104									
	Basic concepts of floating- point arithmetic- Conditioning of a problem-Numerical stability of an algorithm – Linear systems: direct methods (Gauss elimination, LU factorization, Choleski) – Iterative methods (Jacobi –Gauss-Seidle – SOR). Approximation of Functions: polynomials and piecewise polynomial interpolation, splines, discrete least squares. Nonlinear equations: Newton's method and its discrete variants, fixed point iteration. Numerical integration: Newton- Cotes formulas, Gaussian quadrature rules, composite rules. Initial value problems for ordinary differential equation: one-step methods (Runge-Kutta methods) and multistep (Adams) methods. Stiff problems									
References	Numerical Methods for Engineers Author: Steven Chapra and Raymond Canali Publisher: Macgraw Hill 7th edition(2014) ISBN-13: 978-0073397924									

Discipline Elective Courses

Elective Group E-2

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
EPES303	Electric Drive System	3	2	0	2	1	0	0		5
	Pre-requisites: EPES201									
	Power Electronic Converters for Motor Drives: Controlled Rectifiers, DC Choppers, Inverters. DC Motor Drives: Structure and Operation of DC Motors, Types of DC Motors, Thyristor and Chopper DC Drives. Induction Motor Drives: Motor Structure and Operation, Speed Control, Inverter-fed Drives. Stepper Motor Drives: Principle of Operation, Motor Characteristics, Drive Circuits. Course Project.									
References	P. C. Sen, Principles of Electric Machines and Power Electronics, 3rd ed., Wiley, 2013									
MDPS352	Machine Design	3	2	0	3					5
	Pre-requisites: MDPS261									
	Design procedures – Factors affecting design details – Selection of materials – Modes of loading – Safety factors and allowable stresses – Design variants and inversions. The various design calculations. Interpretation and usage of component data sheets. Design of detachable joints: (threaded joints, keys and splines) – Design of permanent joints: (welding, interference fitting, riveting, riveting, adhesion) – Design of some machine elements: springs, power screws. Applications to small-scale mechanical systems. Course project.									
References	Richard Budynas, Keith Nisbett, Shigley's Mechanical Engineering Design, 10th Edition, McGraw Hill, 2014.									
MDPS241	Manufacturing Processes I	3	2	0	1	2				5
	Pre-requisites: PHYS001									
	Examination of metal cutting processes including turning, shaping, drilling and milling. Mechanics of cutting, chip formation, shear plane, velocity relations, merchant circle, tool material, tool wear, tool life, economy in metal cutting. Introduction and definitions of metrology – Gauges – Errors in measurement – Linear and angle measuring instruments test of geometrical shape: straightness and flatness.									
References	Fundamentals of Machining and Machine Tools, Geoffrey Boothroyd, 3rd edition, Taylor & Francis Inc									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MDPS217	Machine Drawing	3	1	2	0	2				5
	Pre-requisites: INTS001									
	Sketching and drafting of actual Mechanical components and Assemblies - Assembly drawing, working drawing, dimensioning, limits, fits, Geometrical and dimensional tolerances, surface roughness. Standard machine elements (threads, fasteners, locking devices, keys, splines, gears, pulleys, bearings, pipe connections, etc.) - Welding and riveting conventions. Standardization and designation of machine elements. Computer aided graphics application.									
References	David A. Madsen, David P. Madsen, Engineering Drawing and Design, 6th Edition, Cengage Learning, 2016.									
MDPS432	Pressure Vessels and Piping	3	2	2	0	0	0	0		4
	Pre-requisites: 85 credits + AA Approval									
	Introduction to ASME Boiler, Pressure Vessels, and Piping Codes. Section VIII Divs. 1 and 2. B31 code series. Material selection. Basic principles in design. Types of loads. Failure theories. Design for internal and external pressure. Design of end closures with various geometries. Design of openings and nozzles. Fabrication requirements. Non-destructive examination and testing. Piping stress and flexibility analyses, design and selection of piping supports. Computer implementation of general-purpose software packages. course project									
References	Baldev Raj, B.K. Choudhary, K. Velusamy, Pressure Vessels and Piping, Volume I: Codes, Standards, Design and Analysis, Alpha Science International, 2009.									
MEPS333	Automotive Systems	3	2	0	2	1	0	0		5
	Pre-requisites: MEPS201									
	ICE Driven systems, Electrical driven systems – Automatic control – Autonomous Automotives – Emissions and environmental impact – Automotive Economics – Advances in Automotive systems.									
References	Engineering Fundamentals of the internal combustion engines, Willard W Pulkrabek									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS402	Sea Water Desalination	3	2	0	2	1	0	0		5
	Pre-requisites: MCNS326.									
	Introduction - Basics of Desalination Technologies: Thermal. Membrane, Electrical, and Chemical - Co-Generation Systems - Desalination Using New and Renewable Energy Sources - Economics of Desalination.									
References	1. Fundamentals of Salt Water Desalination, Author(s): H.T. El-Dessouky, H.M. Ettouney 2. Desalination: Water from Water, Author(s): Jane Kucera 3. Renewable energy technologies for water desalination by Hacene Mahmoudi, Noreddine Ghaffour, Mattheus F.A Goosen, Jochen Bundschuh 4. Sustainable Water for the Future: Water Recycling versus Desalination, Isabel C. Escobar and Andrea I. Schäfer (Eds.)									
MEPS403	Heat Exchangers Design	3	2	0	2	1	0	0		5
	Pre-requisites: MCNS326									
	Computer aided engineering; design optimization; Matlab programming; optimization module; one dimensional system flow analysis; general applications; fluid mechanics review; pipe and tubing standards; hydraulic resistance – wall friction and minor losses; system behavior & flow networks; pump types & applications; heat transfer review; extended surface heat transfer; longitudinal fins; spines; fin performance; heat exchanger types; basic design method of heat exchangers : effectiveness – NTU analysis, log mean temperature method; forced convection correlations for heat exchangers; heat exchanger pressure drop and pumping power; fouling of heat exchangers; double pipe heat exchangers; shell & tube heat exchangers; compact heat exchangers; plate & shell heat exchangers; applications of heat exchanger design to boilers and evaporators; air cooled radiators, air cooled or water cooled condensers, and wet cooling towers; compact heat exchangers; examples of waste heat recovery									
References	1 -Fundamentals of Heat Exchanger Design / Ramesh K. Shah, Dusan P. Sekulic 2 -Heat Exchanger Design Handbook, 2nd ed / Kuppan Thulukkanam 3 -Fundamentals of Heat and Mass Transfer. 6th ed. / Frank P. Incropera									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
EPES450	Programmable Logic Controllers	3	2	2	0	0				4
	Pre-requisites: EPES303									
	Selecting a proper PLC configuration for a given application. Hardware structure and wiring techniques. Basics of programming (bit and word programming, analogue values processing). Programming sequential control tasks. Structured programming techniques. Networking. Building simple supervisory control and data acquisition (SCADA) system integrated with a PLC for sequential control problems. Course project.									
References	F. Petruzella, Programmable Logic Controllers, 5th ed., McGraw Hill, 2016.									
MDPS381	Fundamentals of Industrial Engineering	3	2	0	3					5
	Pre-requisites: NONE									
	This course provides an introduction to the field of industrial engineering, covering the basic concepts, principles, and tools used by industrial engineers to improve productivity, efficiency, and quality in manufacturing and service industries. Topics covered include production systems design, work methods and measurement, production planning and control, and quality control. The course also covers the history and current state of the field, as well as the various career opportunities available in industrial engineering.									
References	"Introduction to Industrial Engineering" by Avraham Shtub and Jonathan F. Bard.									
MDPS382	Engineering Economy and Financial Management:	3	2	2						4
	Pre-requisites: E-A (GENS120)									
	principles of economics and finance as they apply to engineering projects and organizations, including time value of money, investment analysis, cost estimation, financial accounting, budgeting, risk management, and financial reporting.									
References	"Engineering Economic Analysis" by Donald G. Newnan, Jerome P. Lavelle, and Ted G. Eschenbach.									
MDPS383	Operations Research I	3	2	0	2	1				5
	Pre-requisites: MTHS102									
	Introduction to Operations Research. Formulation of linear programming problems. Graphical solution. The Simplex algorithm. Duality and sensitivity analysis. Transportation and assignment problems. Integer and Goal programming.									
References	Frederick Hillier, Gerald Lieberman, Introduction to Operations Research 11th Edition, McGraw Hill, 2021.									

Program Courses (Compulsory)

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS305	Applied Control Technologies for Energy System	3	2	2	0	0	0	0		4
	Pre-requisites: MTHS003, MEPS224									
	Part-1(Theory of Control): Power systems: Basic principles, system, modeling, design, simulation, analysis. Control systems – transfer functions – closed loop – reduction, response, classical methods – transitional and steady state – stability – Bode diagram – frequency response. Part-2 (Basics of Hydraulics): This is a Self Study and E-learning material using an engineering Automatic control virtual Lab software- Contents: basics of Hydraulic control, Hydraulic pumps and motors – Control valves – Transmission components of power control – pressure and flow valves – Applications for practical Hydrailic circuits.									
References	1- Several Class Notes, Self-Study Files, Reports and Materials prepared by Course Instructor 2- Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall & PEARSON, 2010 3-"Instrumentation and Control- Process Control Fundamentals", www.pacontrol.com 4. E-Learning Software and Virtual Lab program by "Interactive Industrial Training, Inc.", fluidpowerzone.com, a Newport vertical community 1987 north 1120 west Provo, UT 84604									
MEPS316	Air and Water Pollution and Quality Monitoring	3	2	2	0	0	0	0		4
	Pre-requisites: MCNS202, MEPS203									
	Fundamentals of gas and aerosol measurements with emphasis on major pollutants in the country; theory of operation of measuring instruments; detection and sampling techniques; and calibration techniques; air and water quality pollution control. Air and water quality monitoring. Monitoring stations and Facilities in Egypt and worldwide. Environmental impact assessment									
References	1. Monitoring Water Quality. Pollution Assessment, Analysis, and Remediation - Satinder Ahuja (Eds.) 2. The Design of Air Quality Monitoring Networks - R. E. Munn Ph.D. (auth.) 3. Pollution Control: Management, Technology and Regulations (Air, Water and Soil Pollution Science and Technology) by Horatio R. Velasquez									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS320	Fundamentals and Applications of Solar Energy	3	2	0	2	1	0	0		5
	Pre-requisites: MCNS326									
	Solar energy potential in Egypt- resource assessment measurements - solar geometry- solar thermal applications- flat plate collectors(water-air)- efficiency and Sankey diagram-assessment of yield and solar fraction-evacuated tube collectors- medium temperature concentration of solar energy- high temperature concentration application- solar cooling- solar desalination- poly-generation applications-certification.									
References	Solar Engineering Of Thermal Processes: Photovoltaics And Wind [5 ed.] By John A. Duffie, William A. Beckman, Nathan Blair									
MEPS332	Laboratory of Energy Systems	2	2	0	0	3	0	0		4
	Pre-requisites: MCNS326, MEPS201									
	Engines Performance testing – Spark Ignition Engine -Pressure Ignition Engine – Reciprocating Compressor – Flame Tube Boiler – Centrifugal Pumps – Axial Pumps – Positive displacement pump – Pelton turbine – Kaplan turbine – steam turbine – gas turbine – testing of industrial cooling unit – testing of central air conditioning unit – testing of heat pump									
References	1. Institution of Mechanical Engineers Staff. (2013). Internal Combustion Engines: Performance, Fuel Economy and Emissions. Elsevier Science & Technology. 2. Grimm, N. R., & Rosaler, R. C. (1998). HVAC systems and components handbook. McGraw-Hill. 3. Stoecker, W. F. (1998). Industrial refrigeration handbook. McGraw-Hill Education. 4. Dick, E. (2015). Fundamentals of turbomachines (Vol. 109). Dordrecht, The Netherlands: Springer.									
MEPS404	Nuclear Energy	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS209									
	Introduction and principles of nuclear engineering; generation, transport and transfer of energy in nuclear reactor core; nuclear power plants; pressurized water reactors (PWR), boiling water reactors (BWR); gas-cooled reactors (GCR); fast breeder reactors (FBR); the future of nuclear fusion; reactor safety; power plant site selection; fundamentals of risk assessment and risk mitigation in nuclear engineering									
References	1. Fundamentals of Thermal and Nuclear Power Generation. Yasuo Koizumi (editor), Tomio Okawa (editor), Shoji Mori (editor) 2. Nuclear Energy by Raymond L. Murray, Keith E. Holbert 3. Nuclear energy: principles, practices, and prospects by David Bodansky									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS415	Power Generation	3	2		2					4
	Pre-requisites: 85 credits + AA Approval									
	Review Of Thermodynamics Principles of Power Cycles, Steam Power Plants, Steam Turbine Components, Steam Turbine Maintenance, Power Station Performance, The Turbine Governing Systems, Steam Chests and Valves, Turbine Protective Devices, Turbine Instrumentation, Turbine Governing System, Gas Turbine Fundamentals, Design & Calculations, Gas Turbine Compressors, Combustors, Axial-Flow Turbines, Gas Turbine Materials, Lubrication and Fuel Systems, Gas Turbine Combustion Chamber Design, Gas Turbine Instrumentation and Control Systems, Gas Turbine Performance Characteristics, Gas Turbine Operating and Maintenance Considerations, Gas Turbine Emission Guidelines and Control Methods, Single-Shaft Combined-Cycle Power generation Plants, Selection Considerations of Combined Cycles and Co-Generation Plants, Applications of Co-Generation and Combined Cycle Plants, Cogeneration Application Considerations, Economic and Technical Considerations for Combined Cycle Performance – Enhancement Options, Economics of Combined Cycles Co- Generation Plants, Power Plant Accessories, Draft system , etc..									
References	1. Powerplant Technology By El Wakil (2001) 2. Thermal Power Plant Control and Instrumentation: The control of boilers and HRSGs by David Lindsley, John Grist, Don Parker. (2017) 3. Power Generation Technologies By Paul Breeze									
MEPS420	Fundamentals of Energy in Buildings	2	1	2						3
	Pre-requisites: MEPS421									
	Human comfort, cooling loads estimation, ventilation and natural ventilation in buildings. Energy consumption in buildings. Detailed HVAC computer load estimation tips. Sustainability development gaols in buildings (i.e., Sustainability Categories). One design project is required. Students will use the principles and information given in the course to solve a particular problem. The students will be asked to propose and assess innovative building designs, technologies and operating schemes that will yield an outstanding sustainable building.									
References	ASHRAE GreenGuide Design, Construction, and Operation of Sustainable Buildings 5th Edition									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS421	Fundamentals of Refrigeration and Air Conditioning Design	3	2	2	0	0	0	0		4
	Pre-requisites: MCNS326, MEPS209.									
	Single-stage vapor compression system Multi-stage vapor compression system Introduction to air conditioning and ventilation systems . Fundamentals of HVAC design calculations . Air Conditioning Systems Air transmission through buildings and duct design and fan selection Air distribution within spaces Piping Design and pumps selection									
References	Air-Conditioning System Design Manual Third Edition Howard J. McKew									
MEPS430	Wind Energy Systems Design	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS224									
	Geophysics of wind resources; aerodynamics of horizontal-axis wind turbines; wind turbine performance; design loads; conceptual design of horizontal-axis wind turbines; blade design and its optimization; materials properties and materials selection; mechanical design and safety factors; wind turbine control; installation; wind farms; electrical systems for wind turbines.									
References	Wind Energy Explained Theory, Design and Application by James F. Manwell, Jon G. McGowan, Anthony L. Rogers 2nd ed									
MEPS446	Applications of Turbomachinery	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS436, 102 credits									
	Fans, Compressors, Pumps and Turbines: General selection criteria and charts - Machines in series, Machines in parallel – Selection & Installation requirements as per Manufacturer's Catalogues (air compressors, domestic water pumps, chilled water pumps, centrifugal fans, axial fans etc.) - Vibration and Noise problems and solutions – control of turbomachinery in various application - Best practices in operation - Maintenance – Troubleshooting., Course project									
References	Fluid Mechanics and Thermodynamics of Turbomachiner-7- Edition, by S. L. Dixon, 2014									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS472	Automatic Control	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS224									
	Introduction, definitions and classification of control systems, Mathematical modeling of control system components, Application to mechanical and electrical systems, Fluid power systems, and thermal systems – Signal flow graph – Stability of linear systems – Analysis of systems in state space – controllability – observability – pole placement – Feedback control system – Control system characteristics – Error analysis – Steady state error for the test input signal using static error coefficients – Dynamic error coefficient and error series – Transient response characteristics – Approximation of higher order systems to second order systems. MATLAB computer simulation and case studies. Course project.									
References	1. Modern control engineering [5th ed] - Prentice Hall.; Ogata, Katsuhiko 2. Automatic Control Systems: With MATLAB by S. Palani 3. Automatic Control Systems - Farid Golnaraghi, Benjamin C. Kuo (2017)									

Program Elective Courses

Elective Group E-3

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS328	Fine Measurements and Laser Diagnostics in Energy System	3	2	2	0	0	0	0		4
	Pre-requisites: MCNS101, MCNS202									
	Transducers - Pressure measurements instruments – Velocity and flow measurements techniques – Introduction to laser – Types of lasers – LDV and PIV technique for flow field – Rayleigh – Raman – LIF for radicals – Imaging techniques for 2-D and 3-D measurements – Test cases.									
References	• Dunn, P. F., & Davis, M. P. (2017). Measurement and data analysis for engineering and science. CRC press. • Dunn, W. C. (2018). Fundamentals of industrial instrumentation and process control. McGraw-Hill Education. • Lipták, B. G. (Ed.). (2003). Instrument Engineers' Handbook, Volume One: Process Measurement and Analysis (Vol. 1). CRC press. • Lipták, B. G. (Ed.). (2018). Instrument engineers' handbook, volume two: Process control and optimization (Vol. 2). CRC press.									
MEPS413	Industrial Process Heating and Cooling	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS320									
	Assessment of process heat temperature and demand- technology selection- estimation of area requirements-hybridization with conventional steam generators and systems- thermal storage- economics of industrial process heat- component testing and certification-absorption cooling driven by solar energy-economics of Solar process heating and cooling.									
References	1. Radiant Heating and Cooling Handbook by Watson R. 2. Combined Heating, Cooling & Power Handbook: Technologies & applications: An Integrated Approach to Energy Resource Optimization by Neil Petchers 3. Solar heating and cooling systems : fundamentals, experiments and applications by Sarbu, Ioan; Sebarchievici, Cal n									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS422	Energy Auditing	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS421									
	Introduction; quick review of energy-related measurements; the energy audit process; energy bills; financial analysis of energy conservation/energy efficiency opportunities; improving energy efficiency through: high-efficiency lighting, improvement and tune-up of combustion systems (boilers and furnaces), HVAC, combined heat and power generation, energy management systems, controls, efficient insulation and refractories, switching to other fuel types; the audit report. The course contains at least one site visit for practice on energy auditing. Group reports will be presented									
References	1. Commercial energy auditing reference handbook , Author(s):Doty, Steve 2. Residential Energy Auditing and Improvement, Author(s): Harbuck, D. D.; Harbuck, Stan									
MEPS425	Renewable Energy	3	2	2	0	0	0	0		4
	Pre-requisites: 85 Credits									
	Introduction. Different Sources of Energy - Solar Energy. Availability of Solar Energy Collection of Solar Energy. Solar Energy Systems. Wind Energy. Characteristics of Wind. Wind Turbine Theory. Wind Energy Conversion Systems. Biomass Energy. Production of Biomass Gases. Systems and Tools for Energy Production from Biomass - Small Hydraulic Turbines and Hydraulic Power - Systems Design of Energy Saving systems.									
References	1. Fundamentals of Renewable Energy Processes, Fourth Edition by Aldo Vieira da Rosa, Juan Carlos Ordonez 2. Renewable Energy Technologies by Jean-Claude Sabonnadi									
MEPS432	Design of Renewable Energy Equipment	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS320									
	General overview of electricity demand, supply, industry structure, interconnected system operations and state of technology; hydro, geothermal, closed system fuel cells; role of power electronic circuits in renewable technologies; economics of various technologies; environmental attributes; engineering principles of electrical storage technologies: electrical vs. chemical energy storage; batteries; double-layer capacitors; superconducting magnetic energy storage; flywheels; demand-side issues: electrical load curve; periodicity; electricity tariff structure and time-of-use tariff; fundamentals of demand-side management; efficiency improvements; load management; electricity market basics; integration of renewable generation into the grid; regulatory policy aspects.									
References	1. Solar PV Power: Design, Manufacturing and Applications from Sand to Systems Author(s):Rabindra Kumar Satpathy, Venkateswarlu Pamuru 2. Solar PV power design, manufacturing and applications from sand to systems, Author(s): Rabindra Satpathy 3. Solar Hybrid Systems: Design and Application, Author(s):Ahmet Aktas, Yagmur Kirçiçek									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS444	Energy Efficiency	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS209, MCNS327									
	Energy Resources, energy efficiency technologies, integration of renewable Energy with energy efficiency measures. Supply and demand side management. Industrial energy efficiency. Energy efficiency in residential, commercial, tourist and transport sectors. Energy efficiency policies, standards, codes and benchmarking. Energy auditing and accounting, life cycle Assessment, Economics and financing of Energy Efficiency options. Environmental mpact of energy efficiency.									
References	1. Energy Efficiency Indicators: Fundamentals on Statistics 2. Energy Efficiency and Management for Engineers by Mehmet Kanoglu, 2020 3. Energy Efficiency: Concepts and Calcuations 1st Edition, Kindle Edition by Daniel Martinez (Author), Ben W. Eberhack (Author), Travis Wagner (Author)									
MEPS475	Hydroelectric Power Plants	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS436, MEPS224									
	Fundamentals of Hydraulic Power Stations Engineering- Evaluation of Hydraulic Power Resources - Generation Equipmert - Structures of Hydraulic Power Stations -Saving of Hydraulic Power - Water Hammer - Spreading and Operation of Hydraulic Power Stations.									
References	Hydroelectric Power Plants: Step by Step by Geraldo Magela Pereira									
MEPS431	Sustainability and Design for Environment	3	2	2	0	0	0	0		4
	Pre-requisites: 60 Credits									
	Analysis and design of technology systems within the context of the environment, economy, and society. Applies the concepts of resource conservation, pollution prevention, life cycle assessment, and extended product responsibility. Examines the practice, opportunities, and role of engineering, management, and public policy. Presents and discusses the computation structure and data sources for environmental Life Cycle Assessment. Uses Life Cycle Assessment to analyze materials, products, and services. The analysis either identifies opportunities for improvements or selects a superior alternative on the basis of pollution prevention and resource conservation									
References	1. Engineering Applications in Sustainable Design and Development, SI Edition by Bradley Striebig ‹Adebayo A. Ogundipe ‹Maria Papadakis 2. Sustainable Design: The Science of Sustainability and Green Engineering by Daniel A. Vallero, Chris Brasier									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS438	Hydrogen technologies for a sustainable energy system	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS203									
	Hydrogen from an energy system perspective - Hydrogen production (technologies) - Hydrogen and renewable energy carriers - Carbon recycling and circular economy - Hydrogen applications - Outlook and Vision									
References	1. Hydrogen and Fuel Cell: Technologies and Market Perspectives by Johannes Töpler, Jochen Lehmann 2. Hydrogen Storage and Technologies by Reimund Neugebauer 3. Hydrogen and Fuel Cells. Emerging Technologies and Applications by Bent Sorensen (Auth.)									
MEPS439	Fundamentals of Photovoltaics	3	2	2	0	0	0	0		4
	Pre-requisites: MEPS209									
	The fundamentals of photoelectric conversion: charge excitation, conduction, separation, and collection. The commercial and emerging photovoltaic (PV) technologies and various cross-cutting themes in PV: conversion efficiencies, loss mechanisms, characterization, manufacturing, systems, reliability, life-cycle analysis, and risk analysis. Other topics covered include photovoltaic technology evolution in the context of markets, policies, society, and environment.									
References	1. Honsberg, C., and S. Bowden. Photovoltaics: Devices, Systems and Applications CD-ROM. [A free online resource.] 2. Wenham, S., M. Green, et al., eds. Applied Photovoltaics. 2nd ed. Routledge, 2006. ISBN: 9781844074013. [Preview with Google Books] 3. Luque, A., and S. Hegedus, eds. Handbook of Photovoltaic Science and Engineering. John Wiley & Sons, Ltd, 2003. ISBN: 9780471491965.									
Elective Group E-4										
MEPS407	Fire Extinguishing Systems	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS224, MEPS203									
	Fundamental of Fire Science - Explosions - Fire Models - Fire and Smoke Spread - Fire Safety Equipment-Design of hydrants – Fire Pumps – Sprinkler Systems Design – Inert Gas Systems – Foam Systems – Fire Codes									
References	1. NFPA 2001 : standard on clean agent fire extinguishing systems 2018 2. Fire Fighting Pumping Systems at Industrial Facilities									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS411	Concentrated Solar Power (CSP)	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS320									
	Low, medium and high temperature applications- parabolic trough concentrator-linear Fresnel concentrator- Sterling Dish concentrator-heliostats/Solar tower-heat transfer fluid-use of CSP with Rankine, combined, Gas Turbine and Sterling cycles- thermal storage strategies- Operation and Maintenance practices-project planning-Economics.									
References	1. The performance of concentrated solar power systems: modelling, measurement and assessment by Heller, Peter 2. Solar Engineering Of Thermal Processes: Photovoltaics And Wind [5 ed.] By John A. Duffie, William A. Beckman, Nathan Blair									
MEPS412	Energy Storage	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS320									
	Introduction to the need for storage- storage efficiency- storage density-thermal energy storage technology- sensible heat storage- latent heat storage- phase change materials-thermal mass storage-chilled water/ice storage-thermochemical storage-compressed air storage-hydroelectric storage-batteries- super conducting magnetic storage- super capacitors- hydrogen as a storage medium-comparison of storage technologies.									
References	1. Renewable Energy Conversion, Transmission, and Storage by Bent Sorensen 2. Thermal Energy Storage: Systems and Applications, Second Edition [2 ed.] by Ibrahim Dincer, Marc Rosen									
MEPS414	Advanced CFD	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS224									
	Turbulence models – Combustion models – Buoyant flows and flows inside buildings – body fitted coordinate system in CFD – Flow in sudden pipe contraction – modeling of a fire in a test room – prediction of flow and heat transfer in a complex flow tube – Laminar flow in a circular pipe driven by periodic pressure variations									
References	1. Computational Fluid Mechanics and Heat Transfer, Third Edition Author(s): Anderson, Dale; Pletcher, Richard H.; Tannehill, John CALL 2. Computational methods for fluid dynamics by Ferziger J.H 3. Computational Fluid Dynamics: A Practical Approach, Author(s): Jiyuan Tu, Guan-Heng Yeoh, Chaoqun Liu									

Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
MEPS417	Pollution control equipment design	2	2	0	2	0	0	0		4
	Pre-requisites: MCNS202, MEPS203									
	Review of fluid mechanics; particle dynamics; design of dust removal equipment: settling chambers, cyclones, baghouse filters, electrostatic precipitators; treatment of sulfur oxides; treatment of nitrogen oxides; pollution control cost estimation.									
References	1. Air Pollution Control Equipment Selection Guide 2nd Edition, by Kenneth C. Schifftner 2. Air Pollution Control Equipment Calculations 1st Edition, by Louis Theodore 3. Air Pollution Control Equipment Kindle Edition by H. Brauer (Author), Y. B. G. Varma (Author) Format: Kindle Edition									
MEPS418	PV Technology and its applications	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS320									
	Introduction to power generation from solar energy - Fundamentals of solar cell operation – electrical and optical properties of solar cells – Installation and operation of solar cells – Equivalent electrical circuits – crystal cells – Fine membrane cells – Cells matrices formation – Calibration and testing of solar cells – connection to the grid and operation without grid.									
References	1. Photovoltaic Systems: Fundamentals and Applications, Author(s): Yaman Abou Jieb, Eklas Hossain 2. Photovoltaic Water Pumping Systems: Concept, Design, and Methods of Optimization, Author(s): Tamer Khatib, Dhiaa Halbot Muhsen 3. Photovoltaic Systems Engineering, Author(s): Abtahi, Amir; Messenger, Roger									
MEPS419	Oil Hydraulics and Pneumatics	2	2	0	2	0	0	0		4
	Pre-requisites: MEPS224									
	Introduction to Hydraulics - Hydraulic Oils, Fluid Properties and Filter - Hydraulic Pumps, Motors, Valves and Actuators - Air Preparation and Service Unit - Pneumatic Cylinders, Motors and Valves - Circuit Design - Automation and Simulation of Hydraulics and Pneumatics									
References	1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill. 2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill. 3. Fluid Power with Applications by Anthony Esposito, Pearson. 4. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.									