Program Specification

For

Doctor of Philosophy Degree

in

Mechanical Power Engineering

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For
Doctor of Philosophy Degree in
Mechanical Power Engineering

A- Basic Information

1- Program title: Ph.D in Mechanical Power Engineering.

2- Program type: **Single** ✓ **Double** ☐ **Multiple** ☐

3- Department (s): Mechanical Power Engineering.
Coordinator: Dr. Yassen El-Sayed Yassen
Assistance Coordinator:
4- External evaluator(s): Prof. Ebrahim Abd El Daym
5- Last date of program specifications approval: Bylaw 2000.

B- Professional Information

1- Graduate Attributes:

After completing the program, the graduate would be able to:

A. Proficiency in the application of the basics and the methodologies of scientific research and the use of its different tools to serve professional practice in the field of Mechanical Power Engineering.
B. Apply the analytical approach and using it in the field of Mechanical Power Engineering, as well as the topics that affect his/her professional practice.
C. Apply the specialized knowledge integrated with and the use of appropriate engineering tools, such as, computational facilities, laboratory equipment, necessary for his / her professional practice and project management.
D. Specialized engineering concepts related to his / her professional practice in the field of Mechanical Power Engineering.
E. Show awareness of current problems and modern visions in in the field of Mechanical Power Engineering.
F. Identify professional problems and find solutions for it.
G. Mastery of an appropriate range of specialized professional and intellectual skills and the use of appropriate technology means to carry out a research study, writing a scientific methodology plain. add new information to the knowledge and write scientific paper.
H. Communicate effectively and lead team works effectively.
I. Take good decisions in different professional contexts.
J. Employ available resources to achieve and maintain the highest benefit.
K. Show awareness of his / her role in community development and environmental conservation

in the light of the global and regional variables.

L. Display professional responsibilities and ethical, societal and cultural concerns.
M. Recognize the need to engage to develop him / her academically and being able to learn continuously in the field of Mechanical Power Engineering.
N. Orientation to develop of methods, tools and new techniques of professional practice.
O. Use of appropriate technology to serve professional applications.

2- Program Aims

The graduate of the Master program must be able to:

1. Gain a depth of knowledge, understanding and methodologies of scientific research including professional skills, pertinent software and appropriate technological means to make decisions, employ available resources efficiently, develop new skills to deal with a high-level complex problems, and engage in continuous learning practice in the field of Mechanical Power engineering.
2. Demonstrate sufficient essential knowledge and a deep understanding of concepts, theories, and practice in the field of Mechanical Power engineering, as well as the topics that affect his/her professional practice.
3. Apply the analytical approaches and its technological professional skills to develop techniques for identifying, formulating, solving, analyzing, and designing Mechanical Power Engineering problems.
4. Communicate and lead team works effectively through professional system considering the detrimental impact of the engineer role on society, environment, societal and cultural concerns.
5. Demonstrate knowledge of contemporary, current, and advanced engineering issues related to Mechanical Power Engineering problems.
6. Adopt basics and principles of quality and fundamentals of ethical & legal professional practice of scientific research in the field of Mechanical Power Engineering.
7. Carry out a research study and writing a scientific methodology plain and add new information to the knowledge and write scientific paper.
8. Develop of methods, tools and new techniques of professional practice and use of appropriate technology to serve professional applications.

3- Graduate Attributes with Program Aims

Program Aims	Graduates Attributes
1. Gain a depth of knowledge, understanding and methodologies of scientific research including professional skills, pertinent software, and appropriate technological means to make decisions, employ available resources efficiently, develop new skills to deal with a high-level complex problem, and engage in continuous learning practice in the field of Mechanical Power Engineering.	A, G, J, and I
2. Demonstrate sufficient essential knowledge and a deep understanding of concepts, theories, and practice in the field of Mechanical Power Engineering, as well as the topics that affect his/her professional practice.	C and G

3. Apply the analytical approaches and its technological professional skills to develop techniques for identifying, formulating, solving, analyzing, designing, and analyze risks of the professional practice in Mechanical Power Engineering.	B and F
4. Communicate and lead team works effectively through professional system considering the detrimental impact of the engineer role on society, environment, societal and cultural concerns.	H, K, and L
5. Demonstrate knowledge of contemporary, current, and advanced engineering issues related to Mechanical Power Engineering problems.	D
6. Adopt basics and principles of quality and fundamentals of ethical & legal professional practice of scientific research in the field of Mechanical Power Engineering.	M
7. Carry out a research study and writing a scientific methodology plain and add new information to the knowledge and write scientific paper.	N
8. Develop of methods, tools, and new techniques of professional practice and use of appropriate technology to serve professional applications.	O

4- Intended Learning Outcomes (ILOs) for the whole program

Mechanical Power Engineering Ph.D Program is designed to achieve the above objectives through the following Intended **Learning Outcomes (ILOs)**:

A. Knowledge and understanding			
NAQAAE Academic Reference Standards (ARS)	**ILOs**	**Graduate Attributes**	**Courses Covering such ILOs (by code)**
A1- Theories, basics and specialized knowledge in the field of learning, as well as other related subjects.	a1-1 Understand the theories, basics and specialized knowledge pertinent to a Ph.D thesis in the research field.	A, B, C, D, E, F, G, H, I, J,K, L, M, N, O	Thesis, MEP602,
	a1-2 Understand the theories, basics and specialized knowledge in the field of **Fluid Mechanics and Hydraulic**.		MEP601, MEP603, MEP604, MEP606, MEP614
	a1-3 Understand the theories, basics and specialized knowledge in the field of **Thermodynamics, and Internal Combustion engine.**		MEP600, MEP605
	a1-4 Understand the theories, basics and specialized knowledge in the field of **Heat and Mass Transfer**.		MEP611, MEP612, MEP615

	a1-5 Understand the theories, basics and specialized knowledge in the field of **Turbo-Machinery and Aero-Dynamics**.		MEP608, MEP609, MEP610
	a1-6 Exhibit ability to in detail, creatively, with a high level of clarity and authority, using scientific scrutiny and adequate tools identify, explain, analyze and assess issues pertinent to a Ph.D thesis in the research field, within which the thesis project is placed.		Thesis
A2- Basics, methodologies and ethics of scientific research and its different tools.	a2-1 Recognize Basics, methodologies and ethics of scientific research and its different tools.	K	Thesis
	a2-2 Undertake aspects pertaining to intellectual property rights.		Thesis
A3- Ethical and legal principles of professional practice in the field of specialization.	a3-1 Recognize ethnical and professional responsibility issues arising in the practice of the engineering profession.	K	Thesis
A4- Basics and principles of quality in professional practice in the field of specialization.	a4-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.	F, H, I, N, O	MEP606, MEP608, MEP609, MEP611, MEP612, MEP615, Thesis
	a4-2 Adopt cost-effective practice and resources allocation that does not compromise quality of service.		Thesis
A5- The knowledge related to the impact of professional practice on the Environment, and the work carried out for conservation and preservation.	a5-1 Discuss Social effects of mechanical power engineering technologies.	J	MEP602, EP608, MEP614, Thesis
	a5-2 Recognize the interaction between mechanical power technologies and surrounding environment		MEP601, MEP603, MEP604, MEP606, MEP614, Thesis
B. Intellectual skills			
B1- Analyze and evaluate information in the field of specialization, and relate it to solve problems and formulate theories.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	B, C	MEP600, MEP601, MEP602, MEP603, MEP604, MEP605, MEP606, MEP608, MEP609, MEP610, MEP611, MEP612, MEP614, MEP615
	b1-2 Interpret, analyze, and evaluate a given system specification information and relate it to the design of the required system.		MEP606, MEP609, MEP611, Thesis
B2- Solve specialized problems with available givens and parameters.	b2-1 Apply broad knowledge of modern computational methods and think critically to solve unstructured problems (with	B, C, E	MEP600, MEP602, MEP605, MEP610, MEP612, MEP615, Thesis

	incomplete data) related to mechanical power engineering.		
B3- Perform research and studies to add to the accumulated knowledge.	b3-1 Compare and evaluate published articles and research concerning specified problem related to mechanical power engineering.	A, C, D, E, F, M, N, O	MEP601, MEP603, MEP604, MEP606, MEP608, MEP609, MEP610, MEP611, MEP614, MEP615, Thesis
	b3-2 Perform applied research on industrial and societal concerns problems that add to the existing mechanical power engineering.		Thesis
B4- Write research papers.	b4-1 Write scientific article paper(s) covering an appropriate mechanical power engineering.	A, D, E, F, M, N, O	Thesis
B5- Assess risks in professional practice.	b5-1 Evaluate pros and cons of given methodologies for mechanical power engineering systems development.	J, K	MEP608, MEP609, MEP611, MEP614, MEP615, Thesis
B6- Plan for performance development in the field of practice.	b6-1 Plan to guide progress in his / her professional career.	C, L, M, N, O	Thesis
B7- Take professional decisions in different practical contexts.	b7-1 Acquire decision making capabilities in different situation when facing problems related to analysis, design and development mechanical power engineering systems.	H	Thesis
B8- Be creative and innovative.	b8-1 Demonstrate creative and innovative thinking in problems solving, using latest engineering techniques, skills, and tools.	B, C, E, H, N, O	MEP610, MEP612, MEP615, Thesis
B9-Performing conversations and discussions built on the basis of evidence and proofs.	b9-1 Manage discussions on basis of evidence and proofs	K, L	Thesis
C. Professional and practical skills			
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	A, B, C, D, E, F	MEP600, MEP601, MEP602, MEP603, MEP604, MEP605, MEP606, MEP608, MEP609, MEP610, MEP611, MEP612, MEP614, MEP615, Thesis
	c1-2 Provide practical and/or laboratory services that can help in solving problem related to mechanical power engineering systems..		Thesis
C2- Write and evaluate technical and	c.2-1 Write and evaluate a professional report related to	A, L	MEP600, MEP601, MEP603, MEP604, MEP605,

professional reports.	mechanical power engineering technical matters.		MEP606, MEP608, MEP609, MEP610, MEP611, MEP612, MEP614, MEP615, Thesis
C3- Evaluate and development the means and tools available in the field of practice.	c3-1 Evaluate methods and tools reported in a specified published articles and researches related to mechanical power engineering field.	A, E, F, H, I, M, N, O	MEP602, MEP606, MEP610, MEP612, MEP614, Thesis
C4- Use technology to enhance professional practice.	c4-1 Express competence skills to use technology to advance practice	M, N, O	Thesis
C5- Plan for performance development in the field of practice and enhance performance of others.	c5-1 Plan professional development courses to improve practice and enhance performance of juniors in the field of mechanical power engineering.	M, N, O	Thesis
D. General and transferable skills			
D1- Communicate effectively using all different methods.	d1-1 Express professional and communication skills to innovate and to interact with the scientific community, research team and technocrats involved in multinational companies at global level in the related fields to mechanical power egineering.	G	Thesis
D2- Use information technology to enhance his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	A, F, I, L	MEP600, MEP601, MEP602, MEP603, MEP604, MEP605, MEP606, MEP608, MEP609, MEP610, MEP611, MEP612, MEP614, MEP615, Thesis
	d2-2 Employ the information technology skills to serve his / her career development.		Thesis
D3- Educating and evaluating others.	d3-1 Design standards to evaluate others performance.	G, K	Thesis
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	C, L	MEP600, MEP601, MEP602, MEP603, MEP604, MEP605, MEP606, MEP608, MEP609, MEP610, MEP611, MEP612, MEP614, MEP615, Thesis
D5- Work as team leader as well as a member in larger teams.	d5-1 Practice team working, and lead teams in specified professional jobs.	G	Thesis
D6- Manage scientific meetings and appropriately utilize time.	d6-1 Manage scientific meetings and appropriately utilize time.	G, I	Thesis
D7- Self evaluation and continuous learning.	d7-1 Express a strong foundation of continuous learning so they can maintain their technical competency.	L	MEP602, MEP604, MEP609, MEP611, Thesis

	d7-2 Seek continuous learning through continuous education, organizing and participating in seminars, workshops, national and international conferences.		MEP608, Thesis

5- Program Academic Reference Standards (ARS)

The external references for standards considered in the development of this program were the Academic Reference Standards (ARS) for postgraduate programs prepared by the National Authority for Quality Assurance and Accreditation (NAQAAE) on 2009. These standards set out the attributes and academic characteristics that are expected to be achieved by the end of the program.

6- Program Structure and Contents:

5.1 Program Duration: a minimum of 2 years & a maximum of 5 years (including one year of preparatory courses)

5.2 Program Structure:

Awarding a Ph.D Degree in Mechanical Power Engineering required the study of courses amounting to 12 hours weekly for one academic year. These 12 hours constitute specialized courses are selected by the supervision team and approved by the department council. These courses are chosen from among the 600 – level and are directly related to the topic of his research. Also, required for awarding the Ph.D Degree in Mechanical Power Engineering is the execution of scientific research that terminated by writing a thesis containing the research results and its complete analysis and defending it successfully.

- Grades for all postgraduate courses as well as the overall grade are evaluated as follows:

Distinction	90% or more
Very Good	80% - less than 90%
Good	70% - less than 80%
Pass	60% - less than 70%

- The student fails if he enters the exam and gets less than 60% of the total mark. If a student fails in a certain course repeats all exams courses, for one year only.

5.3 Program Contents (Courses):

- **Specialized Requirements Courses*:**

Course Code	Course Title	Course Hours/Week	Marks Written Exam
MEP 600	Combustion Engineering	3	100
MEP 601	Advanced Fluid Dynamics	3	100
MEP 602	Multi-phase flow	3	100
MEP 603	Water Power Engineering	3	100
MEP 604	Unsteady Flow Of Fluid	3	100
MEP 605	Jet Propulsion	3	100
MEP 606	Turbulent Flow	3	100
MEP 608	Aerodynamics (2)	3	100
MEP 609	Advanced Turbo Mechanics	3	100
MEP 610	Gas Dynamics (2)	3	100
MEP 611	Heat Transfer By Conduction	3	100
MEP 612	Heat Transfer By Convection	3	100
MEP 614	Boundary Layer Theory	3	100
MEP 615	Heat Transfer By Radiation	3	100

* Select only four courses related to the research topic.

7- Evaluation of program intended learning outcomes:

- Written examinations for the preparatory year after 30 weeks.
- An examiners committee is approved by the faculty council (including at least one external examiner). The evaluation of the thesis and the discussion is carried out in an open session.

8- Program Matrix:

The following table explains the ILO's (of the current program) – Course (main ILOs) matrix.

Program Matrix: ILO's (of the current program) – Course (main ILOs) matrix.

Courses Codes	MEP														Thesis
	600	**601**	**602**	**603**	**604**	**605**	**606**	**608**	**609**	**610**	**611**	**612**	**614**	**615**	
ILOs															
a1-1			x												x
a1-2		x		x	x		x						x		
a1-3	x					x									
a1-4											x	x		x	
a1-5								x	x	x					
a1-6															x
a2-1			x												x
a2-2															x
a3-1															x
a4-1							x	x	x		x	x		x	x
a4-2															x
a5-1		x						x					x		x
a5-2		x		x	x		x						x		x
b1-1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
b1-2							x		x		x				x
b2-1	x	x	x			x				x		x		x	x
b3-1				x	x		x		x	x	x		x	x	x
b3-2															x
b4-1															x
b5-1								x	x		x		x	x	x
b6-1															x
b7-1															x
b8-1		x								x		x		x	x
b9-1															x
c1-1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
c1-2															x
c2-1	x	x		x	x	x	x	x	x	x	x	x	x	x	x
c3-1		x	x				x			x		x	x		x
c4-1															x
c5-1															x
d1-1															x
d2-1	x	x		x	x	x	x	x	x	x	x	x	x	x	x
d2-2															x
d3-1															x
d4-1	x	x		x	x	x	x	x	x	x	x	x	x	x	x
d5-1			x												x
d6-1															x
d7-1			x		x				x		x				x
d7-2								x							x

- ***Program Coordination Committee:***

Programme coordinator: **Dr. Yassen El-Sayed Yassen**

Head of the Department: **Prof. Dr. Kamal Ameen Murad**

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: Combustion Engineering	**Code Symbol**: MEP600	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

The aims of the course to understand analyses of basic combustion concepts and its introduction of a wide variety of practical applications that motivate or relate to the various theoretical concepts.

2- Course Objectives

1- Is to understand the main concepts of chemical reaction and ccombustion.
2- Is to recognize the flame classification and its application.
3- Is to determine the methods for flame stabilization.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		

A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-3 Understand the theories, basics and specialized knowledge in the field of **Thermodynamics, and Internal Combustion engine.**	a-1-3-1 Define the concepts of physical meaning and phenomena are used in combustion systems.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to combustion based on the flow equations analysis.
B2- Solve specialized problems with available givens and parameters.	b2-1 Apply broad knowledge of modern computational methods and think critically to solve unstructured problems (with incomplete data) related to mechanical power engineering.	b2-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to combustion systems.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.

C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on combustion systems.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to combustion systems.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about combustion systems.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 3	Introduction to Combustion	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-4 and 6	Mass and Heat Transfer	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-7 and 9	Diffusion Combustion	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-10 and 12	Vaporization of Liquid Droplet	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d4-1-1
Week-13 and 15	Laminar diffusion Flame	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1
Week-16 and 18	Turbulent Diffusion Flames	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-19 and 21	Kinetic in Combustion Phenomenon Chemical Kinetics	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-22 and 24	Spontaneous Combustion and Well Stirred Reactor	9	9	–	–	a1-3-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-25 and 27	Flame Stabilization by Bluff-Bodies and by Air Swirler	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, d2-1-1, d4-1-1

Week-28 and 30	Flame Propagation	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Total		**90**	**90**	–	–	

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-2),	B1 (b1-1), B2 (b2-1),	C1 (c1-1), C2 (c2-1)	D2 (d2-1), D4 (d4-1)

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	Fundamental Concepts	1-6
2nd	Premixed and Diffusion Flames	7-12
3rd	Flame Stabilization	13-18
4th	Atomization and Atomizers	19-24
5th	Droplet Evaporation &Combustion	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics				
		1st	2nd	3rd	4th	5th
Knowledge & Understanding	a-1-2-1 Define the concepts of physical meaning and phenomena are used in water power engineering.	x	x	x	x	x

	a2-2-1 Report and recognize the professional aspects of water power engineering applications and their effects on the Environment.	x		x		
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.	x	x	x	x	x
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to water power engineering.					x
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.	x	x	x	x	x
	c2-1-1 Write and evaluate a professional report on water hammer.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to water power engineering.	x	x	x	x	x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about water power engineering.	x	x	x	x	x

9- Teaching and Learning Method:

Course Intended learning	Teaching and Learning Method

outcomes (ILOs)		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b2-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Written Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-2-1	x											
Intellectual Skills	b1-1-1	x											
	b2-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d5-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	
Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

Essential Books (Text Books)

1. An Introduction to Combustion: Concepts and Applications by Stephen R. Turns (Jan 24, 2011).
2. Combustion, Fourth Edition by Irvin Glassman and Richard Yetter (Sep 8, 2008).
3. Principles of Combustion by Kenneth K. Kuo (Jan 14, 2005).

Recommended Books

1. Fundamentals of Combustion Processes (Mechanical Engineering Series) by Sara McAllister, Jyh-Yuan Chen and A. Carlos Fernandez-Pello (Apr 19, 2011).
2. Combustion Engineering, Second Edition by Kenneth W. Ragland and Kenneth M. Bryden(May 6, 2011).

Course Coordinator: Prof. Dr. Tharwat Messiha Farag

Head of Department: Prof. Dr. Kamal Ameen Morad

Date :

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: Advanced Fluid Dynamics	**Code Symbol**: MEP601	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

The major aim of this course is to understand the basic concepts of advanced fluid dynamics and get better understanding of different flow regimes. To help the post graduate students to add more information about fluid dynamics, dimensional analysis and similarity, boundary layer, potential flow, and viscous flow. Also, get more knowledge about the kinematics of flow – control volume approach, continuity, momentum and energy equations, compressible flow and sonic speed – flow through nozzles, mass, energy and momentum conservations, and its engineering application. Analyze the graphical solution methods of unsteadily laminar flow. This course will also provide students with the ability to select and design of the experimental model by using dimensional analysis and similarity. Discuss the all phenomena associated with such type of flows and different parameters.

2- Course Objectives

1- Demonstration of the knowledge and understanding of the importance of study of advanced fluid dynamics
2- Definitions of the viscous flows, dimensional analysis and similarity, and compressible flow as related to practical applications.
3- Reconcilability of the different equations for fluid flow with different applications.
4- Analysis of different fluid dynamics problems.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-2 Understand the theories, basics and specialized knowledge in the field of **Fluid Mechanics and Hydraulics**.	a-1-2-1 Define the concepts of physical meaning and phenomena are used in advanced fluid dynamics.
A5- The knowledge related to the impact of professional practice on the Environment, and the work carried out for conservation and preservation.	a5-2 Recognize the interaction between mechanical power technologies and surrounding environment	a5-2-1 Report and recognize the professional aspects of advanced fluid dynamics applications and their effects on the Environment.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to advanced fluid dynamics based on the flow equations analysis.
B3- Link and integrate diverse knowledge to solve professional problems.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to advanced fluid dynamics.

C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to advanced fluid dynamics problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on Potential and viscous Flows.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to advanced fluid dynamics.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about advanced fluid dynamics.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 2	Euler's equation of motion	6	6	–	–	a1-2-1, a2-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1
Week-3 and 4	Equation of containing irrotational flow	6	6	–	–	a1-2-1, a2-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1

Week-5 and 6	Velocity potential, Stream function in two dimensional flow	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-7 and 8	Two dimensional sources and sinks	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-9 and 10	Two dimensional doubles	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-11 and 12	Circulation	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-13 and 14	Combined flows	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-15 and 16	Complex variables	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-17 and 18	Conferral mapping	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-19 and 20	Steady flow around circular cylinders and circular	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d5-1-1
Week-21 and 22	Dimensional analysis and similarity	6	6	–	–	a1-2-1, a2-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1
Week-23 and 24	Equations for viscous flow	6	6	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1
Week-25 and 26	Flow between parallel boundaries	6	6	–	–	a1-2-1, a2-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1
Week-27 and 28	Flow between concentric cylinders	6	6	–	–	a1-2-1, a2-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1
Week-29 and 30	Theory of lubrication	6	6	–	–	a1-2-1, a2-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1
Total		**90**	**90**	–	–	

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-2), A2 (a2-2)	B1 (b1-1), B3 (b3-1)	C1 (c1-1), C2 (c2-1)	D2 (d2-1), D5 (d5-1)

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	Fluid motion	1-6
2nd	Dimensional Analysis and Similarity	7-12
3rd	Boundary Layer	13-18
4th	Potential Flow	19-24
5th	Viscous Flow	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics				
		1st	2nd	3rd	4th	5th
Knowledge & Understanding	a-1-2-1 Define the concepts of physical meaning and phenomena are used in water power engineering.	x	x	x	x	x
	a5-2-1 Report and recognize the professional aspects of water power engineering applications and their effects on the Environment.	x	x	x		
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.	x	x	x	x	x
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to water power engineering.	x	x	x	x	x
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.	x	x	x	x	x

	c2-1-1 Write and evaluate a professional report on water hammer.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to water power engineering.	x	x	x	x	x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about water power engineering.			x		

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-2-1	x		x		x								
	a5-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.

	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Written Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-2-1	x											
	a5-2-1	x											
Intellectual Skills	b1-1-1	x											
	b3-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d4-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	
Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

Essential Books (Text Books)

1 - Frank M. White, "Fluid Mechanics" Third Edition, McGraw Hill Inc.,1994
2 -Irving H. Shames, Mechanics of Fluids

Recommended Books

1-Munson & Young, Fundamentals of Fluid Mechanics,2006
2- REA, The Fluid Mech. and Dynamics Problem Solver
3- Schaum's, Outline series Fluid Mech. and Hydraulics

Course Coordinator : Prof. Dr. Gamal Hafiz Ahmed Mostafa

Head of Department : Prof. Dr. Kamal Ameen Morad

Date :

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	first year
Date of specification approval	***2020***

A- Basic Information

Title: Multi-Phase Flow	**Code Symbol**: **MEP 602**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Programme Aims:

In our treatment of multi-phase flow behavior, we have two major objectives. In addition to obtaining an understanding of the physical mechanisms that underline multi-phase flow, we wish to develop the means of how to do calculations to describe it. This course is devoted primarily to achieving the former objective. Physical origin are discussed, and relevant dimensionless parameters are viewed and discussed.

With conceptual foundations, established, subsequent chapters are used to develop useful tools for quantifying multi-phase flow effects. Chapter 1 and 2 present methods for computing the multi-phase flow models and its coefficients associated with external and internal flow configurations, respectively. Chapter 3 describes methods for determining these coefficients, and Chapter 4 considers the problem with phase change (gas-liquid).

2- Graduate Attributes:

1- the first objective is to cover the basic principles of multi-phase flow and to present a wealth of real-world engineering applications to give students a feel for engineering practice .
2- Is to develop an understanding of multi-phase flow phenemena, examine the descrbing experimental models that govern the velocity, solid concentration and pressure changes that are applicable to multi-phase flow and determine important dimensionless parameters associated with these models.

3- Is to learn how to estimate multi-phase flow models in order to perform analyses on practical systems experiencing different types of flow under different concentration of materials.
4- Is to use requisite practical inputs for computing multi-phase flow rates and/or material concentration.
5- Is to delineate pertinent trasport phenemena for any process or system involving multi-phase flow.
6- The student should be able to develop representative models for real processes and system and draw from the conclusions diagrams and figures concerning process system according to their design or performance from the attendant analysis.

3- Intended Learning Outcomes (ILOs) for the whole program:

NAQAAE Academic Reference Standards (ARS)	**Programme ILOs that the course contribute in achieving**	**Course ILOs**
A. Knowledge & Understanding		
A1 [Theories, basics and specialized knowledge in the field of multi-phase flow, aswell as the subjects that affect his/her professional practice] & A5- The knowledge related to the impact of professional practice on the Environment, and the work carried out for conservation and preservation.	**a1-1** The basic theories and principles of some other engineering and mechanical engineering disciplines providing support to mechanical power disciplines. **a5-1** Characteristics and properties of materials relevant to mechanical engineering applications.	**a1-1-1** Understand the relation of fluid mechanics science related to the science of multi-phase flow. **a5-1-1** Understand the dependance of the multi-phase flow properties on the natural of the flow parameters.
B. Intellectual skills		

B1 [Analyze and evaluate the information in the field of multi-phase flow, and relate it to solve problems] & B2 [Solve specialized problems with lack of some data and variables based on analytical thinking]	**b1-1** Solve engineering problems and design mechanical power and energy systems, components and elements in a creative and innovative attitude. **b2-1** apply the appropriate tools from mathematics, science, technology, and the know-how gained from the professional experience to analyze mechanical engineering design problems to meet certain needs.	**b1-1-1** select the suitable solution methods for multi-phase flow problems based on the governing momentum, energy, and mass equations together with the boundary conditions. **b2-1-1** show how, with the aid of a computer, numerically (finite-difference) methods may be used to accurately predict multi-phase flow rates within the medium.
C. Professional skills		
C1 [Master the basic as well as the latest professional skills in the field of multi-phase flow problems] & C3 [Evaluate means and tools available in the field of practice]	**c1-1** Use a wide range of analytical and technical tools, techniques and equipment including pertinent software. **c3-1** Apply numerical modeling methods and/or appropriate computational techniques to engineering problems.	**c1-1-1** Apply the knowledge of mathematics (differential equations) and fluid mechanics to derive the differential equation models that describe the flow for different materials. **c3-1-1** apply the numerical methods and/or appropriate software package pertaining to multi-phase flow problems.
D. General skills		
D4 [Use different sources to obtain knowledge and information] & D7 [Learn independently and seek continuous learning]	**d4-1** Work effectively in a team and in multi-disciplinary technical and non-technical environments. **d7-1** Share ideas and communicate effectively in written, oral and graphical	**d4-1-1** Work in a team through the preparation of multi-phase flow reports which are required from the students. **d7-1-1** Share ideas and communicate effectively in written,

	forms.	oral and graphical forms.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	**Tut.**	**Lab.**	
Week-1 and 2	Introduction to multi-phase flow.	3	3	-	-	a1-1-1, a5-1-1, d4-1-1, d7-1-1
Week-3 and 4	Fundamentals of phase equilibrium of single materials.	3	3	-	-	a5-1-1, b-1-1-1, b2-1-1, c1-1-1, c3-1-1
Week-5 and 8	Fundamentals of phase equilibrium of mixture materials.	3	3	-	-	a1-1-1, a5-1-1, b1-1-1, c1-1-1
Week-9	Basics of dynamic equilibrium and equations for bubble growth dynamics effects.	3	3	-	-	a1-1-1, a5-1-1, b1-1-1, c1-1-1
Week-10 and 11	Basics of dynamic equilibrium and equations for bubble growth momentum effects.	3	3	-	-	d4-1-1, d7-1-1
Week-12 and 14	Basics of dynamic equilibrium and equations for bubble growth viscosity effects.	3	3	-	-	a1-1-1, a5-1-1, b1-1-1, b2-1-1, c1-1-1
Week-15 and 16	Description of two-phase flow regimes.	3	3	-	-	d4-1-1, d7-1-1
Week-17 and 19	Two phase flow regimes (gas-liquid).	3	3	-	-	a1-1-1, a2-1-1, b1-1-1, b2-1-1, c1-1-1, c3-1-1
Week-20 and 21	Two phase flow regimes (gas-solid).	3	3	-	-	a1-1-1, a5-1-1, b1-1-1, c1-1-1
Week-22	Two phase flow regimes (liquid-solid).	3	3	-	2	a1-1-1, a5-1-1, b1-1-1, c1-1-1
Week-23 and 25	Description of two-phase flow regimes models.	3	3	-	-	a5-1-1, b1-1-1, c1-1-1, d4-1-1, d7-1-1
Week-26 and 27	Two phase flow regimes models for void fraction.	3	3	-	2	a1-1-1, b1-1-1, c1-1-1, c3-1-1, d4-1-1
Week-28	Two-phase flow regimes models for pressure drop.	3	3	-	2	a1-1-1, a5-1-1, b1-1-1, b2-1-1, c1-1-1, d4-1-1, d7-1-1

Week-29 and 30	Boiling modes.	3	3	-	2	a1-1-1, a5-1-1, b1-1-1, c1-1-1, c3-1-1, d4-1-1

5- Relationship between the course and the programme

Field	Academic Reference Standard (NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contribute in achieving	**A1 (a1-1)** and **A5 (a5-1)**	**B1 (b1-1)** and **B2 (b2-1)**	**C1 (c1-1)** and **C3 (c3-1)**	**D4 (d4-1)** and **D7 (d7-1)**

6- Course Subject Area:

A	**B**	**C**	**D**	**E**	**F**	**G**	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	30%		70%				100%

7- Course Topics.

Topic No.	Topic	Weeks
1st	Phase Equilibrium of single materials and mixtues	1-7
2nd	Basics of dynamic equilibrium and equations for bubble growth dynamics, momentum and viscosity effects	7-15
3rd	Two=phase flow regimes, models for void fraction and pressure drop calculations	15-22
4th	Boiling modes	22-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics			
		1st	2nd	3rd	4th
Knowledge & Understanding	**a1-1-1** Understand the relation of fluid mechanics science related to the science of multi-phase flow.	**x**	**X**	**X**	**X**
	a5-1-1 Understand the dependance of the multi-phase flow properties on the natural of the flow parameters.	**X**	**x**	**X**	**X**
Intellectual Skills	**b1-1-1** select the suitable solution methods for multi-phase flow problems based on the governing momentum, energy, and mass equations together with the boundary conditions.	**x**	**x**	**X**	**x**
	b2-1-1 show how, with the aid of a computer, numerically (finite-difference) methods may be used to accurately predict multi-phase flow rates within the medium.	**x**	**X**	**x**	**x**
Professional Skill	**c1-1-1** Apply the knowledge of mathematics (differential equations) and fluid mechanics to derive the differential equation models that describe the flow for different materials.	**x**	**x**	**X**	**x**

	c3-1-1 apply the numerical methods and/or appropriate software package pertaining to multi-phase flow problems.	**x**	**x**	**X**	**x**
General Skills	**d4-1-1** Work in a team through the preparation of multi-phase flow reports which are required from the students.	**x**	**x**	**X**	**x**
	d7-1-1 Share ideas and communicate effectively in written, oral and graphical forms.	**x**	**x**	**X**	**x**

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		**Teaching and Learning Method:**												
		Lecture	**Presentation and Movies**	**Discussion**	**Tutorial**	**Problem solving**	**Brain storming**	**Projects**	**Site visits**	**Self learning**	**Cooperative**	**Discovering**	**Modelling**	**Playing**
Knowledge & understanding	a1-1-1	X				x								
	a5-1-1	X				x								
Intellectual Skills	b1-1-1	X				x								
	b2-1-1	X				x								
Professional Skills	c1-1-1	X				x							x	
	c3-1-1	X				x							x	
General Skills	d4-1-1		X							X	x			

	d7-1-1		X							x	x			

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Proiect Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-1-1	x											
	a5-1-1	x											
Intellectual Skills	b1-1-1	x											
	b2-1-1	x											
Professional Skills	c1-1-1	x											
	c3-1-1	x											
General Skills	d4-1-1	x											
	d7-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	**100**	**32th**
Final Oral Examination		
Mid term written Examination		
Tutorial discussion, presentation, and report assessment		

Total	**100%**	

12- Facilities required for teaching and learning:

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- "Slurry Transport Using Centrifugal Pumps" by Wilson K C et al. Elsevier Scince Publishers Ltd, England, 1992.
2- "A Design Handbook for Slurry Transfer Systems" by Ed N P Brown et al. Elsevier Scince Publishers Ltd, England, 1990..

Course coordinator: Prof. IMAM AHMED EL_SAWAF
Programme coordinator: : Prof. IMAM AHMED EL_SAWAF
Head of the Department: Prof. KAMAL MORAD

Date:.

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: Water Power Engineering	**Code Symbol**: MEP603	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

The major aim of this course is to understand the basic concepts of water power engineering, with the basic knowledge and skills of the concepts and principles of fluid dynamics and hydraulics. To help the post graduate students to add more information about water power engineering, hydraulic turbines, power plant construction, water hammer, and cost water power. Also, get more knowledge about the flow data and water power estimates and its engineering application. Analyze the speed and pressure regulation with engineering applications. This course will also provide students with the ability to select and design of the gausses effects and protection on the water power systems.

2- Course Objectives

1- Demonstration of the knowledge and understanding of the importance of study of water power engineering.
2- Definitions of the Waterways and penstocks, Power house equipment, and Plant accessories as related to practical applications.
3- Reconcilability of the different equations for fluid flow with different applications.
4- Analysis of different Speed and pressure regulations.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-2 Understand the theories, basics and specialized knowledge in the field of **Fluid Mechanics and Hydraulics**.	a-1-2-1 Define the concepts of physical meaning and phenomena are used in water power engineering.
A5- The knowledge related to the impact of professional practice on the Environment, and the work carried out for conservation and preservation.	a5-2 Recognize the interaction between mechanical power technologies and surrounding environment	a5-2-1 Report and recognize the professional aspects of water power engineering applications and their effects on the Environment.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.
B3- Link and integrate diverse knowledge to solve professional problems.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to water power engineering.

C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on water hammer.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to water power engineering.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about water power engineering.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 3	Study of flow data and water power estimates.	9	9	–	–	a1-2-1, a5-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1
Week-4 and 6	Hydraulic turbines	9	9	–	–	a1-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1
Week-7 and 9	Power plant construction.	9	9	–	–	a1-2-1, a5-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1

Week-10 and 12	Waterways and penstocks	9	9	–	–	a1-2-1, a5-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1
Week-13 and 15	Power house equipment	9	9	–	–	a1-2-1, a5-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1
Week-16 and 18	Plant accessories	9	9	–	–	a1-2-1, a5-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1
Week-19 and 21	Speed and pressure regulation	9	9	–	–	a1-2-1, a5-2-1, b1-1-1, c1-1-1, d2-1-1, d4-1-1
Week-22 and 24	Water hammer	9	9	–	–	a1-2-1, b1-1-1, c1-1-1, c2-1-1, d2-1-1, d4-1-1
Week-25 and 27	Gausses effects and protection	9	9	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1, d4-1-1
Week-28 and 30	Cost and value water power	9	9	–	–	a1-2-1, b1-1-1, b3-1-1, c1-1-1, d2-1-1, d4-1-1
Total		**90**	**90**	–	–	

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-2), A2 (a5-2)	B1 (b1-1), B3 (b3-1)	C1 (c1-1), C2 (c2-1)	D2 (d2-1), D5 (d4-1)

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	Water power engineering	1-6
2nd	Hydraulic turbines	7-12
3rd	Power plant construction	13-18
4th	Water hammer	19-24
5th	Cost and value water power	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics				
		1st	2nd	3rd	4th	5th
Knowledge & Understanding	a-1-2-1 Define the concepts of physical meaning and phenomena are used in water power engineering.	x	x	x	x	x
	a5-2-1 Report and recognize the professional aspects of water power engineering applications and their effects on the Environment.	x		x		
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.	x	x	x	x	x
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to water power engineering.					x
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.	x	x	x	x	x
	c2-1-1 Write and evaluate a professional report on water hammer.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to water power engineering.	x	x	x	x	x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about water power engineering.	x	x	x	x	x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-2-1	x		x		x								
	a5-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Written Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-2-1	x											
	a5-2-1	x											
Intellectual Skills	b1-1-1	x											
	b3-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d4-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	
Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

Essential Books (Text Books)

1- Frank M. White, "Fluid Mechanics", 4th ed., McGraw-Hill, INC. 1999.

1- Peter K. Bridn, "Hydraulic Fluids", John Wiley & Sons, Inc. New York, 1996.

Recommended Books

2- Larry W. Mays, “Hydraulic Design Handbook”, McGraw-Hill, 2004.
2- Irving H. Shames, "Mechanics of Fluids", 3rd ed. McGraw-Hill, INC. 1992.

Course Coordinator : Prof. Dr. Fawzy Mohamed El-Otla

Head of Department : Prof. Dr. Kamal Ameen Morad

Date :

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: Unsteady Fluid Flow	**Code Symbol**: MEP604	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

This course aims to provide the student with Origins of unsteady flow; unsteady flow in pipes and ducts; simplified method of analysis, method of characteristics; boundary conditions for method characteristics analyses; graphical and numerical procedures for solving the characteristics equations; application of solution techniques for practical problems; pressure exchangers and other devices with unsteady flow.

2- Course Objectives

1- The student should be able to coverthe basic princibles of unstaedy fluid flows.
2- The student should be able to develop an understanding of methods of controlling transients.
3- The student should be able to delineate pertinent trasport phenemena for any process or system involving unstaedy fluid flow.
4- The student should be able to develop representative models for real processes and system and draw conclusions concerning process/system design or performance from the attendant analysis.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1- Theories, basics and specialized knowledge in the field of learning, as well as other related subjects.	a1-2 Understand the theories, basics and specialized knowledge in the field of Fluid Mechanics and Hydraulics.	a1-2-1 Understand the concepts of unsteady flow. a1-2-2 Understand the different factor that affect the flow and affect the transient conditions
A5- The knowledge related to the impact of professional practice on the Environment, and the work carried out for conservation and preservation.	a5-2 Recognize the interaction between mechanical power technologies and surrounding environment.	a5-2-1 Understand the application of solution techniques for practical problems; pressure exchangers and other devices utilizing unsteady flow.
B. Intellectual skills		
B1- Analyze and evaluate information in the field of specialization, and relate it to solve problems and formulate theories.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to analyse problems related to unsteady fluid flow applications.
B3- Perform research and studies to add to the accumulated knowledge.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to unsteady fluid flow.

C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to unsteady fluid flow problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on unsteady fluid flow measurements and similarity.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to unsteady fluid flow and its applications.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about unsteady fluid flow and its applications.
D7- Self evaluation and continuous learning.	d7-1 Express a strong foundation of continuous learning so they can maintain their technical competency.	d-7-1-1 Use different sources of information journals, internet access facilities, etc. to upgrade and enhance their knowledge.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1	Fluid flows classifications	3	3	-	-	a1-2-1,a1-2-2,
Week-2	Unstaedy flow- inertia of pressure.	3	3	-	-	a1-2-1,a1-2-2,a2-2-1
Week-3	Pressure transients	3	3	-	-	a1-2-2,a2-2-2, b1-1-1, b3-1-1
Week-4	Pipe networks.	3	3	-	-	a2-2-1, b3-1-1
Week-5	Water Hummer	3	3	-	-	a2-2-1, b3-1-1, b1-1-1
Week-6	water Hummer in Turbines	3	3	-	-	a2-2-1, b3-1-1
Week-7	Surge Tanks- design	3	3	-	-	a2-2-1, b3-1-1
Week-8	Method of characteristics	3	3	-	-	c2-1-1, d2-1-1, d4-1-1, d7-1-1
Week-9-14	Oil Pipeline transients	3	3	-	-	a1-2-2, b3-1-1
Week-15-17	Methods of controlling transients	3	3	-	-	a1-2-2, c1-1-1, c2-1-1
Week-18-22	Reciprocating Pumps	3	3	-	-	a2-2-1, b3-1-1
Week-23-25	Turbines	3	3	-	-	a2-2-1,b3-1-1,d2-1-1
Week-26-27	Applications for Compressible fluids	3	3	-	-	a2-2-1, c2-1-1
Week-28-30	Computer programming aids	3	3	-	2	c1-1-1, d2-1-1, d4-1-1, d7-1-1

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-2-1, a1-2-2), A2 (a2-2-1)	B1 (b1-1-1), B3 (b3-1-1)	C1 (c1-1-1), C2 (c2-1-1)	D2 (d2-1-1), D4 (d4-1-1), D7 (d7-1-1)

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**20%**	**70%**	**-10--**	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	unsteady flow basics, applications	1-3
2nd	pipeline network , transient design constains	4-10
3rd	hydraulic machines	11-17
4th	applications for compressible fluids	18-24
5th	Computer programming aids	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)	Course topics				
	1st	2nd	3rd	4th	5th

Knowledge & Understanding	a1-2-1 Understand the concepts of unsteady flow.	x				
	a1-2-2 Understand the different factor that affect the flow and affect the transient conditions	x	x			
	a2-2-1 Understand the application of solution techniques for practical problems; pressure exchangers and other devices utilizing unsteady flow.	x	x	x	x	
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to analyse problems related to unsteady fluid flow applications.	x	x			
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to unsteady fluid flow.	x	x	x		
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to unsteady fluid flow problems, using latest engineering techniques, skills, and tools.					x
	c2-1-1 Write and evaluate a professional report on unsteady fluid flow measurements and similarity.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to unsteady fluid flow and its applications.		x	x		x

	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about unsteady fluid flow and its applications.		x			x
	d-7-1-1 Use different sources of information journals, internet access facilities, etc. to upgrade and enhance their knowledge.		x			x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-2-1	x		x										
	a1-2-2	x		x		x								
	a2-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			
	d7-1-1			x						x				

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and

	tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-2-1	x											
	a1-2-2	x											
	a2-2-1	x											
Intellectual Skills	b1-1-1	x	x										
	b3-1-1	x		x									
Professional Skills	c1-1-1	x								x			
	c2-1-1	x					x						
General Skills	d2-1-1			x									
	d4-1-1						x						
	d7-1-1						x						

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	
Quizzes	---	

laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- "Mechanics of Fluids" , (AlfredJohn), Eighth Edition, 2006
2- "Mechanics of Fluids", by Irving Shames, Third edition, 1993.
3- „Fluid Mechanics“, Joseph Franzini, E. Finnemore, Ninth edition, 1997

Periodicals, Web sites, etc

- *Journal of Fluids Engineering*
- *International Journal for Numerical Methods in Fluids*

Course coordinator: Dr. Amany Saif.
Programme coordinator: Prof. Kamal Morad.
Head of the Department: Prof. Kamal Morad

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: **Jet Propulsion**	**Code Symbol**: MEP605	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

* This course covers the operating principles of jet engines such as turbojet, turboprop , turbofan, and rocket engines. Both the fundamental mathematics and hardware are addressed. Numerous examples based on modern engines are included so that students can grasp the methods and acquire an appreciation of different representative physical parameters. A student is expected to understand the individual steps of analyzing an entire engine or an individual component and to develop an appreciation of trend analysis of engine performance.

* Solved examples enable the students to interpret the working cycles configurations of the different jet propulsion engines, characteristics study of the engine components and for the whole engine, and matching of the engine component at different flight conditions using computational approach.

2- Course Objectives

1- Cycle Analysis for different engines are defined, the fundamental thermodynamic and gas dynamic behavior of the various components are covered, and ideal and non-ideal analyses are performed on each type of engine considered as a whole. Fundamental applicable thermodynamic principles are reviewed in details. The performance of each individual component is studied, including trend studies and quantitative analysis, along with methodologies for presentation. The effects of non-ideal characteristics.

2- Jet propulsion engines classifications, working principles, perormance study at different flight conditions.
3- System matching and analysis are considered, so that engine performance can be predicted for both on-and off-design conditions.
4- Flight performance of the aerovehicle including range and endurance, lift and drag effects, and all other performance parameters are studied.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-3 Understand the theories, basics and specialized knowledge in the field of **Thermodynamics, and Internal Combustion engine.**	a-1-3-1 Define the concepts of physical meaning and phenomena are used in jet propulsion systems.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to jet propulsion based on the flow equations analysis.
B2- Solve specialized problems with lack of some data and variables, (incomplete data).	b2-1 Apply broad knowledge of modern computational methods and think critically to solve unstructured problems (with incomplete data) related to mechanical power engineering.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to jet propulsion systems.

C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to jet propulsion engineering problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on jet propulsion systems.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to jet propulsion systems.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about jet propulsion systems.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 3	Introduction to jet propulsion systems: historical review, classification	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-4 and 6	General review of fundamentals: thermodynamics, gas dynamics, and combustion process.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1

Week-7 and 9	Rocket Propulsion: requirements and capabilities, rocket propulsion engines - types of rocket nozzles, parameters for chemical rockets.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-10 and 12	Aircraft Gas Turbine Engine: thrust equation, propulsive efficiency and other definition equations, gas turbine engine components.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d4-1-1
Week-13 and 15	Aircraft Gas Turbine Engine: working cycles, aircraft engine design.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1
Week-16 and 18	Parametric Cycle Analysis of Ideal Engines: steps and assumptions , ramjet, turbojet, turbofan, turboprop.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-19 and 21	Component Performance: inlet and diffuser ,compressor and turbine, combustor and after burn, exhaust nozzle.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-22 and 24	Parametric Cycle Analysis of Real Engines - Engine Performance Analysis- Turbo-machinery: axial-flow compressor, centrifugal-flow compressor, axial-flow turbine, centrifugal-flow turbine.	9	9	–	–	a1-3-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
Week-25 and 27	Inlets, Nozzles, and Combustion Systems- Matching of Aircraft Gas Turbine Components.	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, d2-1-1, d4-1-1
Week-28 and 30	Tutorials and Solved Problems - Tutorials and Solved Problems	9	9	–	–	a1-3-1, b1-1-1, b2-1-1, c1-2-1, c1-1-1, d2-1-1, d4-1-1
	total	90	90			

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course	A1 (a1-2),	B1 (b1-1),	C1 (c1-1),	D2 (d2-1),

contributes in achieving.		B2 (b2-1),	C2 (c2-1)	D4 (d5-1)

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	Introduction to jet propulsion systems - General review of fundamentals - Rocket Propulsion	1-6
2nd	Aircraft Gas Turbine Engine - Parametric Cycle Analysis of Ideal Engines - Component Performance	7-12
3rd	Parametric Cycle Analysis of Real Engines - Engine Performance Analysis	13-18
4th	Turbo-machinery - Inlets, Nozzles, and Combustion Systems	19-24
5th	Matching of Aircraft Gas Turbine Components - Tutorials and Solved Problems	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics				
		1st	2nd	3rd	4th	5th
Knowledge & Understanding	a-1-2-1 Define the concepts of physical meaning and phenomena are used in jet propulsion systems.	x	x	x	x	x
	a2-2-1 Report and recognize the professional aspects of jet propulsion systems applications and their effects on the Environment.	x		x		
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to jet propulsion systems based on the flow equations analysis.	x	x	x	x	x
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to jet propulsion systems.					x

Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to jet propulsion systems problems, using latest engineering techniques, skills, and tools.	x	x	x	x	x
	c2-1-1 Write and evaluate a professional report on water hammer.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related jet propulsion systems.	x	x	x	x	x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about jet propulsion systems.	x	x	x	x	x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modeling	Playing
Knowledge & understanding	a1-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b2-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Written Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-2-1	x											
Intellectual Skills	b1-1-1	x											
	b2-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d5-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	

Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

[1] "Elements of Propulsion Gasturbines and Rockets", by Mattingly, Jack D., Copyright © 2006 by The American Institute of Aeronautics and Astronautics, USA.

[2] "Fundamental of Jet Propulsions and Application", by Flack, Ronald D., Copyright © 2005 by Cambridge University,

Programme coordinator:
Prof. Dr. Nady Naguib Mikhael

Professor of Thermal Power and Heat Engines
Mechanical Power Engineering Department

Prof. Dr. Kamal Ameen Morad

Head of Mechanical Power Engineering Department

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: Turbulent Flow	**Code Symbol**: **MEP606**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

2- The main objective of the course is to understand the phenomena of turbulent flow and its applications. One the main task of the course is to treat the different solutions of the turbulent flow mechanism and solution. Starting the course with the fundamentals of the turbulent flow in different cases, types and problems used in typical engineering systems such as those found in domestic use manufacturing, machinery, and power production. The course is divided into successive modules that cover basics of turbulent flow, different cases of turbulent flow, and the fluid behavior and analysis of the different systems. As well as, the detailed description of the solution of the fluid flow equations and different models used for the solution. The topic of the mathematical formulation of the fluid flow turbulent models solution will be introduced at the end of the course to cover a very important subject in engineering turbulent fluid flow field and applications.

3- Course Objectives

1- Introduce the turbulent flow phenomena and its application in mehcnaical power engineering.
2- Analyze the basic equations of turbulent flow in different cases of open and closed flow.
3- Understand the measurements techniques of turbulent flow.
4- Demonstrate the different turbulent flow models and its mathematical solutions.

5- Describe the availabilty of each turbulent model for solution of certain application, and its error analysis.

4- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-2 Understand the theories, basics and specialized knowledge in the field of Fluid Mechanics and Hydraulics.	a1-2-1 Understand the concepts of turbulent flow. a1-2-2 Understand the different factor that affect the flow and affect the turbulent conditions
A5- The knowledge related to the impact of professional practice on the Environment, and the work carried out for conservation and preservation.	a5-2 Recognize the interaction between mechanical power technologies and surrounding environment.	a5-2-1 Understand the application of solution techniques for practical problems; pressure exchangers and other devices utilizing turbulent flow.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to analyse problems related to turbulent flow applications.

B3- Link and integrate diverse knowledge to solve professional problems.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to turbulent flow.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to turbulent flow problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on turbulent flow measurements and similarity.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to turbulent flow and its applications.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about turbulent flow and its applications.

D7- Self evaluation and continuous learning.	d7-1 Express a strong foundation of continuous learning so they can maintain their technical competency.	d-7-1-1 Use different sources of information journals, internet access facilities, etc. to upgrade and enhance their knowledge.

5- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1	Introduction and general revision of fluid flow concept and types	3	3	-	-	a1-2-1,a1-2-2,
Week2-5	Definition of turbulent fluid flow and nature of turbulence, applications and case study	12	12	-	-	a1-2-1,a1-2-2,a5-2-1
Week6-11	General equation of turbulent fluid flow and applications, and solution for flat plate and tubes	18	18	-	-	a1-2-2,a5-2-2, b1-1-1, b3-1-1
Week12-15	Measurement devices of turbulent flow and case study	12	12	-	-	a5-2-1, b3-1-1
Week16-18	General differential equation of fluid flow (Naveir Stock's)	6	6	-	-	a5-2-1, b3-1-1, b1-1-1
Week19-24	Turbulent models and solution of turbulent equations and case studies	12	12	-	-	a5-2-1, b3-1-1
Week25-27	Group seminars in turbulent flow applications	9	9	-	-	a5-2-1, b3-1-1
Week28-30	General Revision on the course	6	6	-	-	c1-1-1, c2-1-1, d2-1-1, d4-1-1, d7-1-1

6- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-2-1, a1-2-2), A2 (a2-2-1)	B1 (b1-1-1), B3 (b3-1-1)	C1 (c1-1-1), C2 (c2-1-1)	D2 (d2-1-1), D4 (d4-1-1), D7 (d7-1-1)

7- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

8- Course Topics.

Topic No.	Topic	Weeks
1st	Introduction and general revision of fluid flow concept and types	1-3
2nd	Definition of turbulent fluid flow and nature of turbulence, applications and case study	2-5
3rd	General equation of turbulent fluid flow and applications, and solution for flat plate and tubes - Measurement devices of turbulent flow and case study	6-15
4th	General differential equation of fluid flow (Naveir Stock's) - Turbulent models and solution of turbulent equations and case studies	16-25
5th	Group seminars in turbulent flow applications - General Revision on the course	26-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)	Course topics				
	1st	2nd	3rd	4th	5th

Knowledge & Understanding	a1-2-1 Understand the concepts of unsteady flow.	x				
	a1-2-2 Understand the different factor that affect the flow and affect the transient conditions	x	x			
	a2-2-1 Understand the application of solution techniques for practical problems; pressure exchangers and other devices utilizing unsteady flow.	x	x	x	x	
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to analyse problems related to unsteady fluid flow applications.	x	x			
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to unsteady fluid flow.	x	x	x		
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to unsteady fluid flow problems, using latest engineering techniques, skills, and tools.					x
	c2-1-1 Write and evaluate a professional report on unsteady fluid flow measurements and similarity.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to unsteady fluid flow and its applications.		x	x		x

	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about unsteady fluid flow and its applications.		x			x
	d-7-1-1 Use different sources of information journals, internet access facilities, etc. to upgrade and enhance their knowledge.		x			x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-2-1	x		x										
	a1-2-2	x		x		x								
	a2-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			
	d7-1-1			x						x				

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.

	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-2-1	x											
	a1-2-2	x											
	a2-2-1	x											
Intellectual Skills	b1-1-1	x	x										
	b3-1-1	x		x									
Professional Skills	c1-1-1	x								x			
	c2-1-1	x					x						
General Skills	d2-1-1			x									
	d4-1-1						x						
	d7-1-1						x						

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	

Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- Frank M. White, " Fluid mechanics ", 4th edition, 2001, Mc Graw Hill.
2- Tuncere Cebici, "Analysis of turbulent flow", 2004, Elsevir LTD.
3- D. Drikakis and B.J. Geurts, " Turbulent Flow Compiutation", 2004, KLUWER ACADEMIC PUBLISHERS, NEW YORK.

Periodicals, Web sites, etc

- *Journal of Fluids Engineering*
- *International Journal for Numerical Methods in Fluids*

Course coordinator: Prof. Dr Eng Ayman Mohamed

Programme coordinator: Prof. Dr Eng Kamal Morad

Head of the Department: Prof. Dr Eng Kamal Morad

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: Aerodynamics(2)	**Code Symbol**: MEP608	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

Students has been revised to include the main concepts in flow control and boundary layers, and their influence on modern wing design, as well as introducing recent advances in the understanding of fundamental fluid dynamics. Computational methods have been considered to estimate the main forces and momentums to design and research in the aeronautical industry.

2- Course Objectives

1- Is to establish geometrical features of the aircrafts and, wings and airfoils.
2- Is to estimate the required thrust force applied on different aircrafts.
3- Is to understand and to analysis of body pressure distribution for a perfect fluid and in addition to the real one.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-5 Understand the theories, basics and specialized knowledge in the field of **Turbo-Machinery and Aero-Dynamics**.	a-1-5-1 Define the concepts of physical meaning and phenomena are used in aerodynamics.
A4- Basics and principles of quality in professional practice in the field of specialization.	a4-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.	a4-1-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.
B3- Link and integrate diverse knowledge to solve professional problems.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to aerodynamics.
C. Professional and practical skills		
C1- Master the basic as	c1-1 Express competence	c1-1-1 Express competence skills, such

well as the latest professional skills in the field of specialization.	skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	as identifying, formulating, analyzing, and creating engineering solutions related to aerodynamics problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on wings and aircrafts.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to aerodynamics.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about aerodynamics.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 3	Airfoils & Wings	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-4 and 6	Other Different Airplane components	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-7 and 9	Airfoil Characteristics	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d4-1-1
Week-10 and 12	Force Representation	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d4-1-1
Week-13 and 15	Lift and Drag and Lift/Drag Ratio	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1

Week-16 and 18	Pitching Momentum	9	9	–	–	a1-5-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-19 and 21	Airfoil Balance	9	9	–	–	a1-5-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-22 and 24	Airfoil Stability	9	9	–	–	a1-5-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-25 and 27	Aspect Ratio	9	9	–	–	a1-5-1, c1-1-1, c2-1-1,d2-1-1, d4-1-11
Week-28 and 30	Plan Form Influences	9	9	–	–	a1-5-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Total		**90**	**90**	–	–	

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-5), A4 (a4-1)	B1 (b1-1), B3 (b3-1),	C1 (c1-1), C2 (c2-1)	D2 (d2-1), D4 (d4-1),

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	Airfoils & Wings	1-6
2nd	Other Different Airplane components	7-12
3rd	Airfoil Characteristics	13-18
4th	Lift and Drag and Lift/Drag Ratio	19-24
5th	Airfoil Balance and Stability	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics				
		1st	2nd	3rd	4th	5th
Knowledge & Understanding	a-1-2-1 Define the concepts of physical meaning and phenomena are used in aerodynamics.	x	x	x	x	x
	a4-1-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.	x		x		x
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.	x	x	x	x	x
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to aerodynamics.				x	x
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.	x	x	x	x	x
	c2-1-1 Write and evaluate a professional report on water hammer.			x	x	x
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to aerodynamics.	x	x	x	x	x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and	x	x	x	x	x

	enhance their conceptual knowledge about aerodynamics.					

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-5-1	x		x		x								
	a4-1-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-5-1	x											
	a4-1-1	x											
Intellectual Skills	b1-1-1	x											
	b3-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d4-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	
Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

Essential Books (Text Books)

1- Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series), Tata McGraw-Hill, 1985.

2- Fundamentals of Aerodynamics (Mcgraw Hill Series in Aeronautical and Aerospace Engineering), John Anderson, 2010.

Recommended Books

1- Fundamentals of Astrodynamics (Dover Books on Aeronautical Engineering) by Roger R. Bate, 1971.
2- Jet Engines: Fundamentals of Theory, Design and Operation, Klaus Hunecke, 1997.

Course Coordinator: Prof. Dr. Tharwat Messiha Farag

Head of Department: Prof. Dr. Kamal Ameen Morad

Date :

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title: **Advanced Turbo Mechanics**	**Code Symbol**: MEP609	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

The study of Turbo mechanics is of great importance in many engineering fields. The aims of this course are to provide the Post graduate Student, in Mechanical Engineering Programme, with the basic knowledge of Advanced Turbo Mechanics. The first chapter deals in great detail with thermodynamics, properties of gases and steam and their influence on the operation of various equipments in the power plant stations. The next chapter discusses the dynamic of compressible flow through nozzles and blades. Flow through axial single and multistage turbines are discussed in chapters three. The analysis in two dimensional cascades is discussed in chapter four. Chapter five discusses the basic characteristics flow through axial and radial fans and compressors. Many of illustrative numerical examples are discussed. SI system of units is adopted throughout of this course.

2- Course Objectives

1- Demonstration of the knowledge and understanding of the importance of turbomachines
2- Defination of the requirements of the turbomachine design
3- Recognizability of the different types of turbomachines.
4- Evaluation of the suitable protection schemes for turbomachines
5- Analysis of different steam turbines, gas turbines, fans, and air compressors.
6- Understand the main operating characteristics of steam turbines, gas turbines, fans, and air compressors.

7- Be able to experimentally determine pressure – volume curves for the turbomachines.
8- Preparing students to communicate and work effectively in team and multi-disciplinary technical environments

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-5 Understand the theories, basics and specialized knowledge in the field of **Turbo-Machinery and Aero-Dynamics**.	a-1-5-1 Define the concepts of physical meaning and phenomena are used in advanced turbo mechanics.
A4- Basics and principles of quality in professional practice in the field of specialization.	a4-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.	a4-1-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to advanced turbo mechanics based on the flow equations analysis.

B3- Link and integrate diverse knowledge to solve professional problems.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to advanced turbo mechanics.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to advanced turbo mechanics problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on compressors and turbines.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to advanced turbo mechanics.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about advanced turbo mechanics.

4- Course Contents

Week	*Topic*	*Total*	*Contact hrs*	*Course ILOs*

No.		*Hours*	Lec.	Tut.	Lab.	*Covered (By No.)*
Week-1 and 3	Introduction: Dimensional Analysis—Basic Thermodynamics and Fluid Mechanics - Introduction to Turbomachinery, Types of Turbomachines, Compressible Flow Machines - Basic Thermodynamics, Fluid Mechanics, and Definitions of Efficiency - Continuity Equation - The First Law of Thermodynamics - Newton's Second Law of Motion - The Second Law of Thermodynamics: Entropy	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-4 and 6	Efficiency and Losses of Steam and Gas Turbines, Fans, and air Compressors - Nozzle and diffuser Efficiency, Energy Transfer in Turbomachinery, The Euler Turbine Equation - Examples and Problems.- Illustrative example and solved problems	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-7 and 10	Steam Turbines - Introduction, Steam Nozzles, Nozzle Efficiency - The Reheat Factor - Metastable Equilibrium - Illustrative example and solved problems - Stage Design - Impulse Stage - The Impulse Steam Turbine - Reaction Turbine - Pressure Compounding (The Rateau Turbine) - Velocity Compounding (The Curtis Turbine)- Illustrative example and solved problems	12	12	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d4-1-11
Week-11 and 14	Axial Flow Steam Turbines, Degree of Reaction - Cascade design - Illustrative example and solved problems - Axial Flow and Radial Flow Steam Turbines - Introduction to Axial Flow Turbines - Velocity Triangles and Work Output - Degree of Reaction - Blade-Loading Coefficient, Stator (Nozzle) and Rotor Losses	12	12	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d4-1-1
Week-15 and 17	Radial Flow Turbine, Velocity Diagrams and Thermodynamic, Analysis - Turbine Efficiency, Application of Specific Speed - Illustrative example and solved problems.	9	9	–	–	a1-5-1, a4-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1
Week-18 and 20	Two dimensional cascades - Types of turbine cascades - Losses in the turbine cascades, profile, secondary and total losses - Analysis of total losses - Illustrative example and solved problems	9	9	–	–	a1-5-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-11
Week-21 and 24	Axial Flow and Radial Flow Fans air Compressors - Introduction to Axial air Compressors - Velocity Triangles and Work Output - Degree of Reaction - Blade-Loading Coefficient, Stator (Nozzle) and Rotor Losses - Still in Compressors	12	12	–	–	a1-5-1, b3-1-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1

Week-25 -30	Design of Axial flow Turbines and Compressors - Blade Design - Cascade Design - Computer Programs	12	12	–	–	a1-5-1, c1-1-1, c2-1-1,d2-1-1, d4-1-1

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-5), A4 (a4-1)	B1 (b1-1), B3 (b3-1),	C1 (c1-1), C2 (c2-1)	D2 (d2-1), D4 (d4-1),

6- Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7- Course Topics.

Topic No.	Topic	Weeks
1st	**Definitions, Dimensional Analysis—Basic Thermodynamics and Fluid Mechanics, introduction to turbomachinery, Efficiency**	1-6
2nd	**Classification of Turbomachines, Compressible Flow Machines Basic Thermodynamics, Fluid Mechanics, and Definitions of Efficiency.**	7-12
3rd	**Definitions, application of steam impulse and reaction turbines, single and multi stages, cascade design**	13-18
4th	**Definition of Axial and Radial flow gas turbines Velocity Diagrams and Thermodynamic, Analysis, Turbine Efficiency, Application of Specific Speed**	19-24
5th	**Definition of Axial Flow Compressors and Fans, Introduction, Velocity Diagram, Degree of Reaction, Stage Loading, Lift-and-Drag Coefficients, Cascade Nomenclature and Terminology, two dimensional cascades, Design of axial flow turbines and compressors, and two dimensional cascades.**	25-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)	Course topics				
	1st	2nd	3rd	4th	5th

Knowledge & Understanding	a-1-2-1 Define the concepts of physical meaning and phenomena are used in aerodynamics.	x	x	x	x	x
	a4-1-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.	x		x		x
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to water power engineering based on the flow equations analysis.	x	x	x	x	x
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to aerodynamics.				x	x
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to water power engineering problems, using latest engineering techniques, skills, and tools.	x	x	x	x	x
	c2-1-1 Write and evaluate a professional report on water hammer.			x	x	x
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to aerodynamics.	x	x	x	x	x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about aerodynamics.	x	x	x	x	x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		Teaching and Learning Method												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-5-1	x		x		x								
	a4-1-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning	Assessment Methods

Outcome (ILOs)		Wirtten Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-5-1	x											
	a4-1-1	x											
Intellectual Skills	b1-1-1	x											
	b3-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d4-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	32 th
Mid term written Examination	---	
Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- **White, F. M. (2008), Fluid Mechanics, Sixth Edition, McGraw-Hill.**
2- **Rama S.R. Gorla and Aijaz A. Khan, (2003) "Turbomachinery "Design and Theory", Marcel Dekker, Inc.**
3- **L. L. Faulkner MECHANICAL ENGINEERING, A Series of Textbooks and Reference Books, Columbus Division, Battelle Memorial Institute and Department of Mechanical Engineering, The Ohio State University, Columbus, Ohio**

Course Prof. Atef M. Alm-Edin
Programme coordinator:
Head of the Department: Prof. Dr. Kamal Ameen Morad

Date:.

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	first year
Date of specification approval	***2020***

A- Basic Information

Title: Gas dynamics (2)	**Code Symbol**: **MEP610**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	By law 2000

B- Professional Information

1- Course Aims:

In our treatment of convection, we have two major objectives. In addition to obtaining an understanding of the physical mechanisms that underline gas dynamics, we wish to develop the means of perform gas dynamics calculations. This course is devoted primarily to achieving the former objective. Physical origins are discussed, and relevant dimensionless parameters are developed.

With conceptual foundations established, subsequent chapters are used to develop useful effects in gas dynamics. The course deals with the subsonic and supersonic flow. It also describes the behavior of the flow in adiabatic and diabatic form.

2- Course Objectives

1- the first objective is to cover cover the basic principles of convection heat transfer and to present a wealth of real-world engineering applications to give students a feel for engineering practice .
2- Is to develop an understanding of boundary gas dynamics, examine the differential equations that govern the velocity and temperature fields taht are aplicable to boundary layer equation and determine important dimensionless parameters associated withgas dynamics.
3- is to learn how to estimate the different parameters in order to perform analyses on thermal systems experiencing different types of flow.
4- Is to use requisite inputs for computing gas dynamics parameters.
5- Is to delineate pertinent trasport phenemena for any process or system involving gasdynamics.

6- The student should be able to develop representative models for real processes and system and draw conclusions concerning process/system design or performance from the attendant analysis.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-5 Understand the theories, basics and specialized knowledge in the field of **Turbo-Machinery and Aero-Dynamics**.	a-1-5-1 Understand the relation of thermodynamic and fluid mechanics sciences the the science of gas dynamics.
A4- Basics and principles of quality in professional practice in the field of specialization.	a4-1 Explain Quality Assurance concepts of different mechanical power components and systems development phases.	a4-1-1 Understand the dependence of the thermo-physical properties of the fluids on the natural of the flow and gas dynamics parameters.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	**b1** Solve engineering problems and design mechanical power and energy systems, components and elements in a creative and innovative attitude	**b1-1** select the suitable solution methods for gas dynamics problems based on the governing momentum, energy, and species conservation equations together with the boundary conditions

B2- Link and integrate diverse knowledge to solve professional problems.	**b2** apply the appropriate tools from mathematics, science, technology, and the know-how gained from the professional experience to analyze mechanical engineering design problems to meet certain needs.	**b2-1** show how, with the aid of a computer, numerically (finite-difference) methods may be used to accurately predict temperatures and heat transfer rates within the medium and its boundary.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	**c1** Use a wide range of analytical and technical tools, techniques and equipment including pertinent software	**c1-1** Apply the knowledge of mathematics (differential equations) and thermodynamics (conservation of energy) to derive the differential equation that govern gas dynamics for different geometries.
C5- Write and evaluate technical and professional reports.	**c5-1** Apply numerical modeling methods and/or appropriate computational techniques to engineering problems.	**c5-1-1** apply the numerical methods and/or appropriate software package.
D. General and transferrable skills		
D1- Use information technology to improve his/her professional practice.	**d1** Work effectively in a team and in multi-disciplinary technical and non-technical environments..	**d1-1** Work in a team through the preparation of gas dynamics reports which are required from the students.
D4- Use different sources to obtain knowledge and information.	**d4** Share ideas and communicate effectively in written, oral and graphical forms.	**d4-1** Share ideas and communicate effectively in written, oral and graphical forms.

4-Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 2	Introduction to gas dynamics	6	4	2	-	A-1-2-1 , a4-1-1 , d1-1, d4-1
Week-3 and 4	Energy equation for adiabatic flow with friction.	6	4	2	-	a4-1-1 , b-1-1, b2-1, c1-1, c5-1
Week-5 and 8	Fanno and Rleigh line	12	8	4	-	a-1-2-1 , a4-1-1 , b1-1, c1-1
Week-9	Normal Shock Wave	3	2	1	-	a-1-2-1 , a4-1-1 , b1-1, c1-1
Week-10 and 11	Thermal flow with friction in a parallel duct	6	4	2	-	d1-1, d4-1
Week-12 and 14	Heat transfer for internal flow.	9	6	3	-	a-1-2-1 , a4-1-1 , b1-1, b2-1, c1-1
Week-15 and 16	One dimensional wave motion	6	4	2	-	d1-1, d4-1
Week-17 and 19	The weak shock , very strong shock	9	6	3	-	a-1-2-1 , a4-1-1 , b1-1, b2-1, c1-1, c5-1
Week-20 and 21	Two dimensional flow	6	4	2	-	a-1-2-1 , a4-1-1 , b1-1, c1-1
Week-22	Steady supersonic flow.	3	2	1	-	a-1-2-1 , a4-1-1 , b1-1, c1-1
Week-23 and 25	Oblique wave, supersonic flow over a wedge.	9	6	3	-	a4-1-1 , b1-1, c1-1, d1-1, d4-1
Week-26 and 27	Weak oblique shock	6	4	2	-	a-1-2-1 , b1-1, c1-1, c5-1, d1-1
Week-28	Supersonic compression.	3	2	1	-	a-1-2-1 , a4-1-1 , b1-1, b2-1, c1-1 d1-1, d4-1
Week-29 and 30	Supersonic compression by turning , Mayer function.	6	4	2	-	a-1-2-1 , a4-1-1 , b1-1, c1-1, c7-1 d1-1
Total		90	60	30	–	

5- Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	**A1**and **A5**	**B1** and **B2**	**C1** and **C5**	**D1** and **D4**

6- Course Subject Area:

A	**B**	**C**	**D**	**E**	**F**	**G**	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	30%	70%	---	---	---	100%

7- Course Topics.

Topic No.	Topic	Weeks
1st	Adiabatic flow with friction	1-7
2nd	Sonic flow	7-15
3rd	Oblique waves	15-22
4th	Supersonic flow	22-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		**Course topics**			
		1st	**2nd**	**3rd**	**4th**
Knowledge & Understanding	**a-1-5-1** Understand the relation of thermodynamic and fluid mechanics sciences the the science of gas dynamics.	**x**	**x**	**x**	**x**

	a4-1-1 Understand the dependance of the thermo-physical properties of the fluids on the natural of the flow and gas dynamics parameters.	**x**	**x**	**x**	**x**
Intellectual Skills	**b1-1** select the suitable solution methods for convection problems based on the governing momentum, energy, and species conservation equations together with gas dynamics.	**x**	**x**	**x**	**x**
	b2-1 show how, with the aid of a computer, numerically (finite-difference) methods may be used to accurately predict gas dynamics characteristics.	**x**	**x**	**x**	**x**
Professional Skill	**c1-1** the knowledge of mathematics (differential equations) and thermodynamics (conservation of energy) to derive the differential equation that govern gas dynamics equations for different geometries.	**x**	**x**	**x**	**x**
	c5-1 apply the numerical methods and/or appropriate software package such gas dynamics problems.	**x**	**x**	**x**	**x**
General Skills	**d1-1** Work in a team through the preparation of gas dynamics reports which are required from the students.	**x**	**x**	**x**	**x**
	d4-1 Share ideas and communicate effectively in written, oral and graphical forms.	**x**	**x**	**x**	**x**

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		8- Teaching and Learning Method:												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a-1-2-1	x				x								
	a4-1-1	x				x								
Intellectual Skills	b1-1	x				x								
	b2-1	x				x								
Professional Skills	c1-1	x				x							x	
	c5-1	x				x							x	
General Skills	d1-1		x							X	x			
	d4-1		x							x	x			

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.

	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Proiect Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a-1-5-1	x											
	a4-1-1	x											
Intellectual Skills	b1-1	x											
	b2-1	x											
Professional Skills	c1-1	x											
	c5-1	x											
General Skills	d1-1	x											
	d4-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	**100**	**32th**
Final Oral Examination		
Mid term written Examination		
Tutorial discussion, presentation, and report assessment		
Total	**100%**	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- "Compressible Fluid Flow" A.Shapiro,John Wiley&Sons,1976.
2- "Gas dynamics", Purohit, Scietific Publisher, 2008.
3- "Fundamintaks of Gas Dynamics", Yadoo, Khanne Publisher, 2008.

Course coordinator: Prof. Mohamed Reda AbdElkader

Head of the Department: Prof. Dr. Kamal Ameen Morad

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	first year
Date of specification approval	***2020***

A- Basic Information

Title: Conduction Heat Transfer	**Code Symbol**: **MEP611**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

The aim of this course is to acquire the student with the essential knowledge to be able to:

2- Identify various kinds of conduction heat transfer that are taking place in a particular system.
3- Design and analyze simple and complex problems of advanced heat conduction working at steady and un-steady situations using analytical, numerical and graphical methods.
4- Modify existing study to consider another mode of heat transfer.

5- Course Objectives

1- Be familiar with the various kinds of conduction heat transfer problems.
2- Know which is likely to be the best procedure to solve problems for particular applications.
3- Understand the key factors in conduction heat transfer problems.
4- Be able to estimate the rate of heat transfer and the temperature distribution analytically, numerically and graphically.

6- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-4 Understand the theories, basics and specialized knowledge in the field of **Heat and Mass Transfer**.	a1-4-1 Analyze the theories of mathematics and sciences are used in conduction hat transfer and its applications.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to conduction hat transfer based on the momentum equation and energy and mass balances.
B2- Solve specialized problems with lack of some data and variables, (incomplete data).	b2-1 Apply broad knowledge of modern computational methods and think critically to solve unstructured problems (with incomplete data) related to mechanical power engineering.	b2-1-1 Apply numerical analysis method to write the computer program to solve problems (with incomplete data) related to heat transfer equipment.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to conduction hat transfer problems, using latest engineering

specialization.	techniques, skills, and tools.	techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on conduction hat transfer measurements and similarity.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to conduction hat transfer.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about conduction hat transfer.

7- Course Contents

Week No.	***Topic***	***Total Hours***	***Contact hrs***			***Course ILOs Covered (By No.)***
			Lec.	**Tut.**	**Lab.**	
Week- 1, 2	The general equation of conduction heat transfer.	6	4	2	-	a1-4-1, d1-1, d4-1
Week-3, 4	The thermal conductivity	6	4	2	-	a1-4-1, b-11--1, b2-1-1, c1-1-1, c2-1-1
Week- 5, 6	Steady state conduction heat transfer in one dimension	6	4	2	-	a1-4-1, b1-1-1, c1-1-1
Week- 7, 8	Concept of thermal resistance	6	4	2	-	a1-4-1, b1-1-1, c1-1-1
Week- 9, 10	Extended surfaces	6	4	2	-	d1-1, d4-1

Week 11, 12	Steady state conduction heat transfer in two dimensions	6	4	2	-	a1-4-1, b1-1-1, b2-1-1, c1-1-1
Week-13, 14	Steady state conduction heat transfer in three dimensions	6	4	2	-	d1-1, d4-1
Week-15, 16	Unsteady state conduction heat transfer in one dimension	6	4	2	-	a1-4-1, b1-1-1, b2-1-1, c1-1-1, c2-1-1
Week-17, 18	Unsteady state conduction heat transfer having mixed boundary conditions	6	4	2	-	a1-4-1, b1-1-1, c1-1-1
Week-19, 22	Numerical solution of one-dimensional unsteady-state heat transfer by conduction	6	4	2	-	a1-4-1, b1-1-1, c1-1-1
Week-23, 25	Graphical solution of unsteady state conduction heat transfer in one-dimension	6	4	2	-	a1-4-1, b1-1-1, c1-1-1, d1-1, d4-1
Week-26, 28	Unsteady state conduction heat transfer in multi – dimensions.	6	4	2	-	a4-1-1, b1-1-1, c1-1-1, c2-1-1, d1-1
Week-29, 30	Time varying boundary conditions, phase change with moving boundaries.	6	4	2	-	a1-4-1, b1-1-1, b2-1-1, c1-1-1 d1-1, d4-1

8- Relationship between the course and the programme

Field	Academic Reference Standard (ARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contribute in achieving	**A1(a1-4)** and	**B1(b1-1)** and B2(**b2-1)**	**C1(c1-1)** and C2(**c2-1)**	**D2(d2-1)** and D4(d4-1)

9- Course Subject Area:

A	**B**	**C**	**D**	**E**	**F**	**G**	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	20%		60%	20%			100%

10- Course Topics.

Topic No.	Topic	Weeks
1st	Genenral Equation of Conduction Heat Transfer	1-8
2nd	Extended Surfaces	9-10
3rd	Steady State Conduction Heat Transfer	11-15
4th	Un-steady State Conduction Heat Transfer	16-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		**Course topics**			
		1st	**2nd**	**3rd**	**4th**
Knowledge & Understanding	a1-4-1 Analyze the theories of mathematics and sciences are used in convection heat transfer and its applications.	**x**	**x**	**x**	**x**
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to convection heat transfer based on the momentum equation and energy and mass balances.	**x**	**x**	**x**	**x**
	b2-1-1 Apply numerical analysis method to write the computer program to solve problems (with incomplete data) related to heat transfer equipment.	**x**	**x**	**x**	**x**
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing,				**x**

	and creating engineering solutions related to convection heat transfer problems, using latest engineering techniques, skills, and tools.	x	x	x	
	c2-1-1 Write and evaluate a professional report on convection heat transfer measurements and similarity.	x	x	x	x
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to convection heat transfer.	x	x	x	x
	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	x	x	x	x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)	**8- Teaching and Learning Method:**												
	Lecture	**Presentation and Movies**	**Discussion**	**Tutorial**	**Problem solving**	**Brain storming**	**Projects**	**Site visits**	**Self learning**	**Cooperative**	**Discovering**	**Modelling**	**Playing**

Knowledge & understanding	a1-4-1	X				x								
Intellectual Skills	b1-1-1	X				x								
	b2-1-1	X				x								
Professional Skills	c1-1-1	X				x							x	
	c2-1-1	X				x							x	
General Skills	d2-1-1		x							X	x			
	d4-1-1		x							x	x			

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		**Assessment Methods**											
		Wirtten Exam	**Oral Exam**	**Tutorial Assessment**	**Proiect Assessment**	**Model Assessment**	**Report Assessment**	**Quiz assessment**	**Presentation Assessment**	**Discussion**	**Laboratory Test**	**Home Exm**	**Monitoring**
Knowledge & Understanding	a1-4-1	x											
Intellectual Skills	b1-1-1	x											
	b2-1-1	x											
Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d4-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	**Percentage**	**week**

Final Examination	**100**	**32th**
Final Oral Examination		
Mid term written Examination		
Tutorial discussion, presentation, and report assessment		
Total	**100%**	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- **Heat Transfer, Abasic approach, M. N. Ozisik, 1985.**
2- **Heat Transfer, J. P. Holman, 1997.**
3- **An Introduction to Mass & Heat Transfer, Priciples of Analysis and Design, Stanley Middleman, 1983.**
4- **Engineering Thermodynamics, Work and Heat Transfer, G. F. C. Rogers And Y. R . Mayhew, Longman Group Ltd., 3rd /e, 1981.**
5- **Engineering Heat Transfer, James R. Welty, SI version, 1978.**

Course co-ordinator: Dr. Ahmed Abd Allah. Elkady.

Programme co-ordinator:

Head of the Department: Prof. Kamal Morad

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	
Date of specification approval	***2020***

A- Basic Information

Title: Heat Transfer by Convection	**Code Symbol**: **MEP612**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

In our treatment of convection, we have two major objectives. In addition to obtaining an understanding of the physical mechanisms that underline convection transfer, we wish to develop the means of perform convection calculations. This course is devoted primarily to achieving the former objective. Physical origins are discussed, and relevant dimensionless parameters are developed.

With conceptual foundations established, subsequent chapters are used to develop useful tools for quantifying convection effects. Chapter 1 and 2 present methods for computing the convection coefficients associated with forced convection in external and internal flow configurations, respectively. Chapter 3 describes methods for determining these coefficients in free convection, and Chapter 4 considers the problem of convection with phase change (boiling and condensing).

2- Course Objectives

1- the first objective is to cover cover the basic principles of convection heat transfer and to present a wealth of real-world engineering applications to give students a feel for engineering practice .

2- Is to develop an understanding of boundary layer phenemena, examine the differential equations that govern the velocity and temperature fields taht are aplicable to boundary layer equation and determine important dimensionless parameters associated with convection heat transfer.

3- is to learn how to *estimate convection coefficients* in order to perform analyses on thermal systems experiencing different types of flow and heat transfer situations.

4- Is to use requisite inputs for computing heat transfer rates and/or material temperatures.
5- Is to delineate pertinent trasport phenemena for any process or system involving heat transfer.
6- The student should be able to develop representative models for real processes and system and draw conclusions concerning process/system design or performance from the attendant analysis.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-4 Understand the theories, basics and specialized knowledge in the field of **Heat and Mass Transfer**.	a1-4-1 Analyze the theories of mathematics and sciences are used in convection heat transfer and its applications.
A3- Main scientific advances in the field of specialization.	a3-1 Classify the Potential applications of advanced mechanical power engineering systems.	a3-1-1 Report new advances in analysis and solving methodologies in convection heat transfer.
	a3-3 Discuss the recent and update developments in the most important themes related to mechanical power engineering	a3-3-1 discuss the recent methods and researches to solve the convection heat transfer problems numerically.
B. Intellectual skills		

B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to convection heat transfer based on the momentum equation and energy and mass balances.
B2- Solve specialized problems with lack of some data and variables, (incomplete data).	b2-1 Apply broad knowledge of modern computational methods and think critically to solve unstructured problems (with incomplete data) related to mechanical power engineering.	b2-1-1 Apply numerical analysis method to write the computer program to solve problems (with incomplete data) related to heat transfer equipment.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to convection heat transfer problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on convection heat transfer measurements and similarity.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to convection heat transfer.

D5- Use different sources to obtain knowledge and information.	d5-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d5-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about convection heat transfer.

4- Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1 and 2	Introduction to convection heat transfer.	6	4	2	-	a1-4-1, a3-1-1, d1-1, d4-1
Week-3 and 4	Energy equation for laminar boundary layer.	6	4	2	-	a1-4-1, a3-3-1, b-11--1, b2-1-1, c1-1-1, c2-1-1
Week-5 and 6	Heat transfer for external flow, The relation between fluid friction and heat transfer	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, c1-1-1
Week-7 and 8	Flow across cylinder and sphere and across tube banks.	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, c1-1-1
Week-9 and 10	Empirical relations for external flow	6	4	2	-	d1-1, d4-1
Week-11 and 12	Heat transfer for internal flow.	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, b2-1-1, c1-1-1
Week-13 and 14	Empirical relations for pipe and tubes	6	4	2	-	d1-1, d4-1
Week-15 and 16	Free convection heat transfer from vertical and horizontal walls and cylinders.	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, b2-1-1, c1-1-1, c2-1-1
Week-17 and 18	Free convection from inclined surfaces, cylinders and sphere	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, c1-1-1
Week-19 and 20	Free convection in enclosed spaces.	6	4	2	-	a1-4-1, a3-1-1, 3-3-1, b1-1-1, c1-1-1
Week-21 and 22	Combined free and forced convection.	6	4	2	-	a1-4-1, a3-3-1, b1-1-1, c1-1-1, d1-1, d4-1
Week-23 and 24	Dimensionless parameters in boiling and condensation, boiling	6	4	2	-	a4-1-1, a3-3-1, b1-1-1, c1-1-1, c2-1-1, d1-1

	modes					
Week-25 and 26	Modes of pool boiling, pool boiling correlations, forced convection boiling.	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, b2-1-1, c1-1-1 d1-1, d4-1
Week-27 - 30	Laminar and turbulent film condensations, condensation in horizontal tube.	6	4	2	-	a1-4-1, a3-1-1, a3-3-1, b1-1-1, c1-1-1, c2-1-1, d1-1

5- Relationship between the course and the programme

Field	Academic Reference Standard (ARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contribute in achieving	**A1(a1-4)** and **A3(a3-1 and a3-3)**	**B1(b1-1)** and B2(**b2-1)**	**C1(c1-1)** and C2(**c2-1)**	**D2(d2-1)** and D5(d5-1)

6- Course Subject Area:

A	**B**	**C**	**D**	**E**	**F**	**G**	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	20%		60%	20%			100%

7- Course Topics.

Topic No.	Topic	Weeks
1st	**Forced Convection: External Flow**	**1-10**
2nd	**Forced Convection: Internal Flow**	**11-14**
3rd	**Free Convection**	**15-22**
4th	**Condensation and Boiling**	**23-30**

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)	**Course topics**

		1st	2nd	3rd	4th
Knowledge & Understanding	a1-4-1 Analyze the theories of mathematics and sciences are used in convection heat transfer and its applications.	x	x	x	x
	a3-1-1 Report new advances in analysis and solving methodologies in convection heat transfer.	x	x	x	x
	a3-3-1 discuss the recent methods and researches to solve the convection heat transfer problems numerically.	x	x	x	x
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to convection heat transfer based on the momentum equation and energy and mass balances.	x	x	x	x
	b2-1-1 Apply numerical analysis method to write the computer program to solve problems (with incomplete data) related to heat transfer equipment.	x	x	x	x
Professional Skill	c1-1-1 Express competence skills, such as identifying,				

	formulating, analyzing, and creating engineering solutions related to convection heat transfer problems, using latest engineering techniques, skills, and tools.	x	x	x	x
	c2-1-1 Write and evaluate a professional report on convection heat transfer measurements and similarity.	x	x	x	x
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to convection heat transfer.	x	x	x	x
	d5-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	x	x	x	x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)	8- Teaching and Learning Method:

		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-4-1	X				x								
	a3-1	X				x								
	a3-3-1	X				x								
Intellectual Skills	b1-1-1	X				x								
	b2-1-1	X				x								
Professional Skills	c1-1-1	X				x							x	
	c2-1-1	X				x							x	
General Skills	d2-1-1		x							X	x			
	d5-1-1		x							x	x			

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-4-1	x											
	a3-1-1	x											
	a3-3-1	x											
Intellectual Skills	b1-1-1	x											
	b2-1-1	x											

Professional Skills	c1-1-1	x											
	c2-1-1	x											
General Skills	d2-1-1	x											
	d5-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	**100**	**32 th**
Final Oral Examination		
Mid term written Examination		
Tutorial discussion, presentation, and report assessment		
Total	**100%**	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- "Fundamentals of Heat and Mass Transfer" by Frank P. Incropera and David P. Dewitt, Seventh Edition, 2011

2- "Heat Transfer; A Practical Approach" by Yunus A. Cengel, Second edition, 2009.

Course Prof. Mohamed Mohamed Shabaan.

Programme coordinator:

Head of the Department: Prof. Kamal Morad

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	1st year
Date of specification approval	***2020***

A- Basic Information

Title :Boundary layer theory	**Code Symbol**: MEP614	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

The study of fluid mechanics is of great importance in many engineering fields. The aims of this course are to provide the Post graduate Student, in Mechanical Engineering Programme, with the basic knowledge of Advanced Fluid Mechanics, especially the Boundary layer theory. The first chapter deals in great detail with properties of fluids and the kinematics of fluid flow. Continuity, momentum, energy and Navier stokes equations and applications are discussed in chapters two. The Laminar viscous flows are discussed in chapter three. In chapter Four, the turbulence and turbulent flow through pipes are given. Boundary layer theory and forces due to flow of fluids over bodies are discussed in chapter Four. Chapter five discusses the characteristics of Laminar and Turbulent boundary layer flow, the basic mechanisms of flow separation. SI system of units is adopted throughout of this course. Many of illustrative numerical examples are discussed. The objective questions included number 100. A total number of 150 exercise problems, mostly with answers are available.

2-Course Objectives

1- **Demonstration the knowledge and understanding the importance of Fluid Mechanics.**
2- **Definition the fluid in motion and requirements of the fluid flow applications.**
3- **Reconcilability the kinematics of fluid flow and different types of fluid flow regimes, Laminar viscous flow, turbulent flow, laminar and turbulent boundary layer flows.**
4- **Evaluation of the suitable analysis schemes for fluid flow in motion, continuity, momentum, energy, Navier-Stoles , Prandtl's boundary layer and van-Karaman Momentum Integral equations.**
5- **Analysis of different fluid flow problems and conducting laboratory experimental verifications.**
6- **Understand the main operating characteristics of boundary layer and flow separation.**

7- **Be able to determine and find out the boundary layer thickness over different body configurations**
8- **Preparing students to communicate and work effectively in team and multi-disciplinary technical environments**

3-Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.	a1-2 Understand the theories, basics and specialized knowledge in the field of Fluid Mechanics and Hydraulics.	a1-2-1 Understand the concepts of Boundary layer theory. a1-2-2 Understand the different factor that affect the flow and affect the transient conditions.
A2- Mutual relation between professional aspects of professional practice and its effects on the Environment.	a2-2 Recognize the interaction between mechanical power technologies and surrounding environment.	a2-2-1 Understand the application of solution techniques for practical problems; pressure exchangers and other devices utilizing Boundary layer theory.
B. Intellectual skills		
B1- Analyze and evaluate the information in the field of specialization, and relate it to solve problems.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to analyses problems related to Boundary layer theory applications.

B3- Link and integrate diverse knowledge to solve professional problems.	b3-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to Boundary layer theory.
C. Professional and practical skills		
C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to Boundary layer theory problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on Boundary layer theory measurements and similarity.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to Boundary layer theory and its applications.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about Boundary layer theory and its applications.

D7- Learn independently and seek continuous learning.	d7-1 Express a strong foundation of continuous learning so they can maintain their technical competency.	d-7-1-1 Use different sources of information journals, internet access facilities, etc. to upgrade and enhance their knowledge.

4-Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-1,2,3	**-Review of basic concepts of fluid in motion. -Description of fluid flow, classification of fluid flows, streamlines, Pathlines, and Streaklines, static, dynamic, total (stagnation) pressures acceleration of a fluid particle**	**9**	**6**	**3**	-	a1-2-1,a1-2-2
Week,4,5,6	**- Fluid flow characteristics, measuring of fluid velocity and pressure head, flow rate and continuity equation. - Definition of control volume, control surface, flow energy, Euler's equation, Bernoulli's theorem and Bernoulli's equation**	**9**	**6**	**3**	-	a1-2-1,a1-2-2,a2-2-1
Week-7,8,9,10	**- Basic information about laminar viscous flows, flow regimes and Reynolds number, critical Reynolds number, Navier Stokes equation, relation between shear stress and pressure gradient, laminar flow in circular pipes- Hagen Poiseuille law. - Illustrative example and solved problems**	**9**	**6**	**3**	-	a1-2-2,a2-2-2, b1-1-1, b3-1-1
Week-11,12,13,15,16	**- Desirable attribute of hydrodynamic lubrication, Dashport mechanism: Movement of piston in a Dashpot., viscous resistance in a Bush Bearing., and viscous resistance in Collar Bearing and Foot Step Bearing. - Illustrative example and solved problems.**	**9**	**6**	**3**	-	a2-2-1, b3-1-1
Week-17,18,19	**- Basic information turbulence and turbulent flow through pipes, growth of instability and transition from laminar to turbulent flow, effect of turbulence, classification of turbulence, Reynolds equations of turbulence, turbulence modeling, flow loss in pipes, Darcy equation for head loss due to frication, Minor head losses, pipe in series and in parallel. - Illustrative example and solved problems**	**9**	**6**	**3**	-	a2-2-1, b3-1-1
Week-20,21,22	**- Application of Navier Stokes and Darcy equations and concept of equivalent pipe, hydraulic gradient and total energy lines, hydraulic transmission of power. - Application examples of Navier Stokes equation and determination of velocity components fluid flows.**	**9**	**6**	**3**	-	a2-2-1, b3-1-1
Week-23,24,25	**Coordination of flow through nozzles, water hammer, hydraulically smooth and rough pipes, Prandtl universal velocity distribution, velocity distribution in smooth and rough pipes. Determination of average velocity distribution for smooth and rough pipes, frication factor for smooth and rough pipes, friction factor charts, - Illustrative example and solved problems**	**9**	**6**	**3**	-	c2-1-1, d2-1-1, d4-1-1, d7-1-1
Week-26,27,30	**- Definition of laminar and turbulent boundary layer flows, Description of boundary layer, boundary layer parameters,**	**9**	**6**	**3**	-	a1-2-2, b3-1-1

	Prandtl's boundary layer equation, Blasius solution for laminar boundary layer flows, van-Karman momentum integral equation. Discusstion of laminar boundary layer and turbulent boundary layer flows and boundary layer flow separation. **- Illustrative examples.**					

5-Relationship between the course and the programme

Field	National Academic Reference Standard(NARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contributes in achieving.	A1 (a1-2-1, a1-2-2), A2 (a2-2-1), A3 (a3-1-1, a3-2-1, a3-3-1)	B1 (b1-1-1), B3 (b3-1-1)	C1 (c1-1-1), C2 (c2-1-1)	D2 (d2-1-1), D5 (d5-1-1), D8 (d8-1-1)

6-Course Subject Area:

A	B	C	D	E	F	G	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	---	**30%**	**70%**	---	---	---	**100%**

7-Course Topics.

Topic No.	Topic	Weeks
1st	**Definitions, Fluid flow characteristics, stream lines, pathlines, streaklines, continuity equation**	**1-6**
2nd	**Basic information about laminar viscous flows, flow regimes and Reynolds number, critical Reynolds number, Navier Stokes equation, relation between shear stress and pressure gradient, laminar flow in circular pipes- Hagen Poiseuille law.**	**7-13**
3rd	**Basic information turbulence and turbulent flow through pipes, growth of instability and transition from laminar to turbulent flow, effect of turbulence, classification of turbulence, Reynolds equations of turbulence, turbulence modeling, flow loss in pipes, Darcy equation for head loss due to frication, Minor head losses, pipe in series and in parallel.**	**16-21**
4th	**Coordination of flow through nozzles, water hammer, hydraulically smooth and rough pipes, Prandtl universal velocity distribution, velocity distribution in smooth and rough pipes.** **Determination of average velocity distribution for smooth and rough pipes, frication factor for smooth and rough pipes, friction factor charts.**	**22-24**
5th	**- Definition of laminar and turbulent boundary layer flows,** **Description of boundary layer, boundary layer parameters, Prandtl's**	**25-30**

	boundary layer equation, Blasius solution for laminar boundary layer flows, van-Karman momentum integral equation. Discusstion of laminar boundary layer and turbulent boundary layer flows and boundary layer flow separation.	

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics				
		1st	2nd	3rd	4th	5th
Knowledge & Understanding	a1-2-1 Understand the concepts of unsteady flow.	x				
	a1-2-2 Understand the different factor that affect the flow and affect the transient conditions	x	x			
	a2-2-1 Understand the application of solution techniques for practical problems; pressure exchangers and other devices utilizing unsteady flow.	x	x	x	x	
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to analyse problems related to unsteady fluid flow applications.	x	x			

	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to unsteady fluid flow.	x	x	x		
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to unsteady fluid flow problems, using latest engineering techniques, skills, and tools.					x
	c2-1-1 Write and evaluate a professional report on unsteady fluid flow measurements and similarity.				x	
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to unsteady fluid flow and its applications.		x	x		x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about unsteady fluid flow and its applications.		x			x
	d-7-1-1 Use different sources of information journals, internet access facilities, etc. to upgrade and enhance their knowledge.		x			x

9- Teaching and Learning Method:

Course Intended learning	Teaching and Learning Method

outcomes (ILOs)		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-2-1	x		x										
	a1-2-2	x		x		x								
	a2-2-1	x		x		x								
Intellectual Skills	b1-1-1	x		x	x	x								
	b3-1-1	x		x	x	x			x					
Professional Skills	c1-1-1			x	x	x	x		x	x	x			
	c2-1-1	x		x	x	x								
General Skills	d2-1-1	x		x	x	x			x	x	x			
	d4-1-1			x	x				x	x	x			
	d7-1-1			x						x				

10- Teaching and learning method for low capacity and outstanding Student

For low capacity students	Assign a portion of the office hours for those students.
	Give them specific tasks.
	Repeat the explanation of some of the material and tutorials.
	Assign a teaching assistance to follow up the performance of these groups of students.
For outstanding Students	Hand out project assignments to those students.
	Give them some research topics to be searched using the internet and conduct presentation.
	Encourage them to take parts in the running research projects.

11- Assessment

11.1 Assessment Methods

Course Intended Learning	Assessment Methods

Outcome (ILOs)		Written Exam	Oral Exam	Tutorial Assessment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exam	Monitoring
Knowledge & Understanding	a1-2-1	x											
	a1-2-2	x											
	a2-2-1	x											
Intellectual Skills	b1-1-1	x	x										
	b3-1-1	x		x									
Professional Skills	c1-1-1	x								x			
	c2-1-1	x					x						
General Skills	d2-1-1			x									
	d4-1-1						x						
	d7-1-1						x						

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	100	31 th
Mid term written Examination	---	
Quizzes	---	
laboratory examination	---	
Oral examination	---	
Semester work	---	
Total	100%	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- **White, F. M. (2008), Fluid Mechanics, Sixth Edition, McGraw-Hill.**
2- **Baker, Bonnie, (1998) "Thermistors in Single Supply Temperature Sensing Circuits", AN685, Microchip Technology Inc.**
3- **Kumar, D.S., (2006), "Fluid mechanics and fluid power engineering", S.K. Kataria & Sons, Delhi-110006**

Course coordinator: Gamal H. Moustafa

Head of the Department: Prof. Dr. Kamal Ameen Morad

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	first year
Date of specification approval	***2020***

A- Basic Information

Title: Heat Transfer by Radiation	**Code Symbol**: **MEP615**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

Thermal radiation is an extremely important process, and in the physical sense it is perhaps the most interesting of the heat transfer modes. It is relevant to many industrial heating, cooling, and drying processes, as well as to energy conversion methods that involve fossil fuel combustion and solar radiation.

This course considers the means by which radiation is generated, the specific nature of the radiation, and the manner in which it interacts with matter. We give particular attention to radiative interactions at the surface and to the properties that must be introduced to describe these interactions. We focus on means for computing radiative exchange between two or more surfaces, between gases and enclosure, combined convection and radiation, applications and numerical solutions for radiation problems.

2- Course Objectives

1- Is to establish geometrical features of the radiation exchange problem by developing the notation of a *view factor*.
2- Is to develop procedure for predicting radiative exchange between surfaces that form an *enclosure*.
3- Is to consider the effects of a *participating medium*, namely, an intervening gas that emits and absorbs radiation.

3- Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1- Theories, basics and specialized knowledge in the field of learning, as well as other related subjects.	a1-4 Understand the theories, basics and specialized knowledge in the field of **Fluid Mechanics and Hydraulics**.	a1-4-1 Analyze the theories of mathematics and sciences are used in radiation heat transfer and its applications.
B. Intellectual skills		
B1- Analyze and evaluate information in the field of specialization, and relate it to solve problems and formulate theories.	b1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to mechanical power engineering.	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to radiation heat transfer based on the equation of energy conservation.
B2- Solve specialized problems with available givens and parameters.	b2-1 Apply broad knowledge of modern computational methods and think critically to solve unstructured problems (with incomplete data) related to mechanical power engineering.	b-2-1-1 Apply numerical analysis method to write the computer program to solve problems (with incomplete data) related to radiation heat transfer equipment.
B3- Perform research and studies to add to the accumulated knowledge.	b3-1 Compare and evaluate published articles and research concerning specified problem related to mechanical power engineering.	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to radiation heat transfer.
C. Professional and practical skills		

C1- Master the basic as well as the latest professional skills in the field of specialization.	c1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions, using latest engineering techniques, skills, and tools.	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to radiation heat transfer problems, using latest engineering techniques, skills, and tools.
C2- Write and evaluate technical and professional reports.	c.2-1 Write and evaluate a professional report on specialized related to mechanical power engineering technical matters.	c2-1-1 Write and evaluate a professional report on radiation heat transfer.
D. General and transferrable skills		
D2- Use information technology to improve his/her professional practice.	d2-1 Use state-of-the-art computer aided design tools for solving mechanical power engineering problems.	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to water power engineering.
D4- Use different sources to obtain knowledge and information.	d4-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge.	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about water power engineering.

4- Course Contents

Week No.	***Topic***	***Total Hours***	***Contact hrs***			***Course ILOs Covered (By No.)***
			Lec.	**Tut.**	**Lab.**	
Week-1 and 2	Fundamental Concepts	3	3	-	-	a4-1-1
Week-3 and 4	Radiation heat flux	3	3	-	-	a4-1-1,, b-1-1-1, b2-1-1, b3-1-1
Week-5 and 6	Radiation intensity	3	3	-	-	a4-1-1, b1-1-1, b2-1-1,b3-1-1
Week-7 and 8	Black body radiation	3	3	-	-	a4-1-1, b1-1-1, b2-1-1,b3-1-1

Week-9 and 10	Emission from real surfaces	3	3	-	-	b1-1, b2-1-1, b3-1-1
Week-11 and 12	Absorption, reflection, and transmission by real surfaces	3	3	-	-	a4-1-1, b1-1-1, b2-1-1, b3-1-1
Week-13 and 14	The view factor	3	3	-	-	a4-1-1, b1-1-1, b2-1,1, b3-1-1, c1-1-1, d2-1-1, d4-1-1
Week-15 and 16	Black body radiation Exchange	3	3	-	-	a4-1-1, b1-1-1, b2-1-1, b3-1-1-, c1-1-1, c2-1-1
Week17 and 18	Radiation exchange between opaque, diffuse, gray surfaces in an enclosure	3	3	-	-	a4-1-1, b1-1-1,, b2-1-1-, b3-1-1, c1-1-1
Week-19 and 20	Multimode heat transfer	3	3	-	2	a4-1-1, b1-1-1, b2-1,1, b3-1-1, c1-1-1, c2-1-1
Week-21 and 22	Implications of the simplifying assumptions	3	3	-	-	a4-1-1, b1-1-1, b2-1-1, b3-1-1, c1-1-1, c2-1-1
Week-23 - 27	Radiation exchange with participating media	3	3	-	2	a4-1-1, b1-1-1, b2-1-1 b3-1-1, c1-1-1, c2-1-1, d2-1-1,d4-1-1
Week-28 - 30	Volumetric absorption, gaseous emission and absorption	3	3	-	2	a4-1-1, b1-1-1, b2-1-1, b3-1-1, c1-1-1, c2-1-1 d2-1-1, d4-1-1

5- Relationship between the course and the programme

Field	Academic Reference Standard (ARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contribute in achieving	**A4(a4-1)**	**B1(b1-1), B2(b2-1)** and B3(**b3,1)**	**C1(c1-1)** and C2(**c2-1)**	**D2(d2-1)** and D4(**d4-1)**

6- Course Subject Area:

A	**B**	**C**	**D**	**E**	**F**	**G**	
Humanities	Mathematics	Basic	Applied	Computer	Projects	Disccretionry	Total

and Social Science	and Basic Sciences	Engineering Science	Engineering And Design	Applications and ICT	and practice	subjects	
---	20%		60%	20%			100%

7- Course Topics.

Topic No.	Topic	Weeks
1st	Fundamental Concepts	1-6
2nd	Radiation properties	7-14
3rd	Black and real bodies radiation	15-25
4th	Radiation exchange with participating media	26-30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics			
		1st	2nd	3rd	4th
Knowledge & Understanding	a1-4-1 Analyze the theories of mathematics and sciences are used in radiation heat transfer and its applications.	x	x	x	x
Intellectual Skills	b1-1-1 Demonstrate an investigatory and analytic thinking approach (Problem solving) to solve problems related to radiation heat transfer based on the equation of energy conservation.	x	x	x	x
	b-2-1-1 Apply numerical analysis method to write the computer program to solve problems (with incomplete data)	x	x	x	x

	related to radiation heat transfer equipment.				
	b3-1-1 Analyze, interpret and manipulate data from a variety of sources and relate it to solve professional problems related to radiation heat transfer.	x	x	x	x
Professional Skill	c1-1-1 Express competence skills, such as identifying, formulating, analyzing, and creating engineering solutions related to radiation heat transfer problems, using latest engineering techniques, skills, and tools.	x	x	x	x
	c2-1-1 Write and evaluate a professional report on radiation heat transfer.			x	x
General Skills	d2-1-1 Use state-of-the-art computer aided design tools for solving professional problems related to water power engineering.		x		x
	d4-1-1 Use different sources of information like library, internet access facilities, etc. to upgrade and enhance their conceptual knowledge about water power engineering.		x		x

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		8- Teaching and Learning Method:												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a4-1-1	x				x								
Intellectual Skills	b1-1-1	x				x								
	b2-1-1	x				x								
	b3-1-1	x				x								
Professional Skills	c1-1-1	x				x							x	
	c2-1-1	x				x							x	
General Skills	d2-1-1		x							x	x			
	d4-1-1		x							x	x			

11- Assessment

11.1 Assessment Methods

Course Intended Learning Outcome (ILOs)	Assessment Methods											
	Wirtten Exam	Oral Exam	Tutorial Assesment	Project Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring

Knowledge & Understanding	a4-1-1	x											
Intellectual Skills	b1-1-1	x											
	b2-1-1	x											
	b3-1-1	X											
Professional Skills	c1-1-1	X											
	c2-1-1	X											
General Skills	d2-1-1	x											
	d4-1-1	x											

11.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	**100**	**32th**
Final Oral Examination		
Mid term written Examination		
Tutorial discussion, presentation, and report assessment		
Total	**100%**	

12- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

13- List of references:

1- "Fundamentals of Heat and Mass Transfer" by Frank P. Incropera and David P. Dewitt, Seventh Edition, 2011

2- "Heat Transfer; A Practical Approach" by Yunus A. Cengel, Second edition, 2009.

Course coordinator: Prof. Kamal Morad.
Programme coordinator: Prof. Kamal Morad.
Head of the Department: Prof. Kamal Morad

Date:

Course Specification

Program on which the course is given	Ph.D. in Mechanical Power Engineering
Major or minor element of program	Major
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic year/Level	first year
Date of specification approval	***2020***

A- Basic Information

Title: Advanced Measurements	**Code Symbol**: **MEP616**	
Lecture	3 hours	
Tutorial		
Laboratory		
Total	3 hours	Bylaw 2000

B- Professional Information

1- Course Aims:

In our treatment of mechanical measurements, we have many major objectives; explaining how to use the laser applications for measurements of fluid flow velocity, concentration of combustion products, temperature and soot concentration, chromatographic chemical analysis of gaseous mixture and flow velocity measurement with hot wire anemometer.

2- Course Objectives

On completion of this course, the student should have sufficient broad knowledge in mechanical engineering to:

1- Demonstrate knowledge of the fundamentals of mechanical measurements;
2- Classify the measurement instruments and measurements types;
3- Demonstrate knowledge of laser applications for measurements;
4- Classify and describe the instruments used to measure the velocity and flow rate;
5- Expalin how to measure the combustion exhaust products concentration;
6- Expalin how to use the high speed camera and its applications.

3-Intended Learning Outcomes (ILOs)

NAQAAE Academic Reference Standards (ARS)	Program ILOs	Course ILOs
A. Knowledge and understanding		
A1.Essential facts, fundamentals, concepts, principles and theories relevant to Mechanical Engineering.	a1-1 Ability to apply knowledge of mathematics, science and engineering	a1-1-1 a1-2 How to classify the measurement types. a1-1-2 How to classify the measurement types.
A2- The constraints which mechanical power engineers have to judge to reach at an optimum solution.	a2-1 The constrains which mechanical power engineers have to judge to reach at an optimum solution.	a2-1-1 How to control combustion emissions. a2-1-2 How to select the measurement instrument according to its properties.
B. Intellectual skills		
B1-Solve engineering problems and design mechanical power and energy systems, components and elements in a creative and innovative attitude.	b1-1 Solve engineering problems and design mechanical power and energy systems, components and elements in a creative and innovative attitude.	b1-1-1 Solve many engineering problems in flow measurements. b1-1-2 How to increase accuracy of measurements.
B3-Analyze and interpret data, and design experiments to obtain new data.	b3-1 Analyze and interpret data, and design experiments to obtain new data.	b3-1-1 How to think in a creative and innovative way in problem solving and design.
C. Professional and practical skills		
C2- Analyze experimental results and determine their accuracy and validity.	C2-1 Analyze experimental results and determine their accuracy and validity.	C2-1-1 Calculate the accuracy of the instruments.

C4- Refer to scientific literature effectively.	c.4-1 Refer to scientific literature effectively.	C4-1-1 Knowledge of science and information technology about the measurements, high speed camera, and chromatograph.
D. General and transferrable skills		
D2- Share ideas and communicate effectively in written, oral and graphical forms.	d2-1 Share ideas and communicate effectively in written, oral and graphical forms.	d2-1-1 How to collaborate effectively within multidisciplinary team. d2-1-2 Motivate the students.
D4-Recognize the importance of considering the environmental, social and economical issues in engineering practice.	d4-1 Recognize the importance of considering the environmental, social and economical issues in engineering practice.	d4-1-1 How to increase the performance of the measurement instruments. d4-1-2 How to control the exhaust emissions from combustion.

4-Course Contents

Week No.	*Topic*	*Total Hours*	*Contact hrs*			*Course ILOs Covered (By No.)*
			Lec.	Tut.	Lab.	
Week-2 1	General Introduction	6	4	2	-	a1-1-1,
Week3-4	Laser Applications for Measurements of Fluid Flow Velocity	6	4	2	-	a1-1, a12-1, b-1-1, b2-1, c1-1, c7-1
Week 5-6	Laser Applications for Measurements of Fluid Flow Velocity	6	4	2	-	a1-1-1, a2-2-1, b1-1-1, c1-1-1
Week 7-8	Concentration Analysis of Combustion Products	6	4	2	-	a1-1-1, a2-2-1, b1-1-1, c1-1-1
Week 9-10	Concentration Analysis of Combustion Products	6	4	2	-	b1-1-1, b3-1-1, c1-1-1
Week 11-12	Temperature and Soot Measurements	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, b3-1-1, c1-1-1,c2-1-1

Week 13-14	Temperature and Soot Measurements	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1, d2-1-1, d4-1-1
Week 15-16	Chromatographic Chemical Analysis of Gaseous Mixture	6	4	2	-	A1-1-1, a2-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1
Week 17-18	Chromatographic Chemical Analysis of Gaseous Mixture	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, c1-1-1
Week 19-20	Flow Velocity Measurements	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, c1-1-1
Week 21-22	Flow Velocity Measurements	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, c1-1-1, c2-1-1, d2-1-1, d4-1-1
Week 23-26	Data Acquisition Systems	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, c1-1-1, d2-1-1
Week27-30	High Speed Cameras	6	4	2	-	a1-1-1, a2-1-1, b1-1-1, b3-1-1, c1-1-1, c2-1-1 d2-1-1, d4-1-1

5- Relationship between the course and the programme

Field	Academic Reference Standard (ARS)			
	Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
Programme Academic Standards that the course contribute in achieving	**A1** and **A2**	**B1** and B3	**C2**and C4	**D2** and D4

6- Course Subject Area:

A	**B**	**C**	**D**	**E**	**F**	**G**	
Humanities and Social Science	Mathematics and Basic Sciences	Basic Engineering Science	Applied Engineering And Design	Computer Applications and ICT	Projects and practice	Disccretionry subjects	Total
---	30%		70%				100%

7- Course Topics.

Topic No.	Topic	Weeks
1st	General Introduction	1 and 2
2nd	Laser Applications for Measurements of Fluid Flow Velocity	3- 6
3rd	Concentration Analysis of Combustion Products	7- 10
4th	Temperature and Soot Measurements	11- 14
5th	Chromatographic Chemical Analysis of Gaseous Mixture	15-18
6th	Flow Velocity Measurements	19-22
7th	Data Acquisition Systems	23- 27
8th	High Speed Cameras	28 - 30

8- ILOs Matrix Topics

Course Intended Learning Outcomes (ILOs)		Course topics							
		1st	2nd	3rd	4th	5th	6th	7th	8th
Knowledge & Understanding	a1-1-1 a1-2 How to classify the measurement types. a1-1-2 How to classify the measurement types.	x	x	x	x	x	x	x	x
	a2-1-1 How to control combustion emissions. a2-1-2 How to select the measurement instrument according to its properties.	x	x	x	x	x	x	x	x
Intellectual Skills	b1-1-1 Solve many engineering problems in flow measurements. b1-1-2 How to increase accuracy of measurements.	x	x	x	x	x	x	x	x
	b3-1-1 How to think in a creative and innovative way in	x	x	x	x	x	x	x	x

	problem solving and design.								
Professional Skill	C2-1-1 Calculate the accuracy of the instruments.	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
	C4-1-1 Knowledge of science and information technology about the measurements, high speed camera, and chromatograph.	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
General Skills	d2-1-1 How to collaborate effectively within multidisciplinary team. d2-1-2 Motivate the students.		**x**		**x**		**x**		**x**
	d4-1-1 How to increase the performance of the measurement instruments. d4-1-2 How to control the exhaust emissions from combustion.		**x**		**x**		**x**		**x**

9- Teaching and Learning Method:

Course Intended learning outcomes (ILOs)		8- Teaching and Learning Method:												
		Lecture	Presentation and Movies	Discussion	Tutorial	Problem solving	Brain storming	Projects	Site visits	Self learning	Cooperative	Discovering	Modelling	Playing
Knowledge & understanding	a1-1-1 a1-1-2	x				x								
	a2-1-1 a2-1-2	x				x								
Intellectual Skills	b1-1-1 b1-1-2	x				x								
	b3-1-1	x				x								
Professional Skills	c2-1-1	x				x							x	
	c4-1-1	x				x							x	
General Skills	d2-1-1 d2-1-2		x							x	x			
	d4-1-1 d4-1-2		x							x	x			

10- Assessment

10.1 Assessment Methods

Course Intended Learning Outcome (ILOs)		Assessment Methods											
		Wirtten Exam	Oral Exam	Tutorial Assessment	Proiect Assessment	Model Assessment	Report Assessment	Quiz assessment	Presentation Assessment	Discussion	Laboratory Test	Home Exm	Monitoring
Knowledge & Understanding	a1-1-1 a1-1-2	x											
	a2-1-1 a2-1-2	x											
Intellectual Skills	b1-1-1 b1-1-2	x											
	b3-1-1	x											
Professional Skills	c2-1-1	x											
	c4-1-1	x											
General Skills	d2-1-1 d2-1-2	x											
	d4-1-1 d4-1-2	x											

10.2 Assessment Schedule and Grades Distribution

Assessment Method	Percentage	week
Final Examination	**100**	**32th**
Final Oral Examination		
Mid term written Examination		
Tutorial discussion, presentation, and report assessment		
Total	**100%**	

11- Facilities required for teaching and learning

Teaching aids like, lecture room with audio-visual facilities, white board.

12- List of references:

1- "Principles of Measurement Systems" by John P. Bentley, Fourth Edition, 2005.
2- "Theory and Design for Mechanical Measurements" by Richard S. Figliola Donald E. Beasley, Fifth Edition, 2011.
3- "Sensitivity and Uncertainty Analysis Theory" by Dan G. Cacuci, Volume 1, 2003.

Course Prof. Dr. Mohamed A. Okeily
Programme coordinator:
Head of the Department: **Prof. Dr. Kamal Ameen Morad**

Date: