Course Specifications of:
Selected Topics in Fluid Dynamics (MEP 702)

Program(s) on which the course is given: Ph.D. in Mechanical Power Engineering
Compulsory or Elective element of program: Compulsory
Department offering the program: Mechanical Engineering / power
Academic year / Level: year/ 2014/2015
Date of specification approval: 2012

A. Basic Information

Title: ***Selected Topics in Fluid Dynamics*** **Code: MEP 702**
Credit Hours: 3 **Lecture: 3**
Tutorial: - **Practical: -** **Total: 3**

B- Professional Information

1- Overall aims of course:

This course introduces students to:

1- Know the tensor forms of basic equation (Both instantaneous and averaged values) and its application in different cases of fluid studies.
2- Analysis different turbulence models and computational codes.
3- Master the boundary layer theory in both laminar and turbulent flows with transition theory.
4- Know experimental methods in fluid research.

2- Intended learning outcomes of course (ILOs)

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

2.1 Knowledge and understanding

a1. Advanced understanding of key perspectives, modern concepts related to fluid mechanics. (2.1.1)
a2. Have advanced knowledge on the effects of fluid mechanics on the environment and ways of development and maintenance of the environment. (2.1.2)
a3. Search for scientific developments in the fluid mechanics. (2.1.3)
a4. Capacity to understand and respect interdisciplinary and diverse cultural perspectives, and the roles and expertise of others professionals. (2.1.4)
a5. Explain the basic principles of ensuring higher levels of quality in fluid mechanics applications practice, (2.1.5).
a6. Illustrate the modern concepts and methodologies used in computational and experimental fluid mechanics research. (2.1.7)

2.2 Intellectual skills

b1. Capable to educate others, which may include teaching and supervision. (2.2.2)
b2. Capability to write scientific papers. (2.2.4)
b3. Assess and analyze risks in the fluid mechanics field. (2.2.5)
b4. Ability to plan and improve the performance in the fluid mechanics field. (2.2.6)
b5. Have creativity and make good decisions in different professional aspects. (2.2.7)
b6. Add new information to the knowledge by carry out a research studies in the mechanical power engineering field.(2.2.10)
b7. Formulate valuable research questions in the fluid mechanics field. (2.2.11)

2.3 Professional and practical skills

c1. Exercise critical judgment in evaluating sources of information, constructing meaning and writing plan of scientific research. (2.3.2)
c2. Adaptation assessment methods and tools existing in the area of the fluid mechanics field. (2.3.3)
c3. Perform presentations for discussing the thesis work. (2.3.5)
c4. Ability to develop innovative solutions, demonstrating flexibility and resourcefulness in the fluid mechanics field.(2.3.8)

2.4 General and transferable skills

d1. Accessing information and managing time at an advanced level. (2.4.2)
d2. Analyzing and synthesizing information or data from a variety of sources and demonstrate effective IT capabilities to serve the development in the fluid mechanics field. (2.4.3)
d3. Adopt self-assessment and adopt life-long learning. (2.4.5)
d4. Ability to demonstrate a high level of competence the management of time and scientific meetings. (2.4.6)
d5. Conduct self-learning and continuous education practices. (2.4.8)

3- Contents

No. of weeks	Topic	No. of hours
1	Navier-Stoke’s equations	3
2	Some exact solutions of Navier-Stoke’s equation	3
3	Experiments in fluid mechanics	3
4	Term paper seminar	3
5	Continuation of boundary layers, stability	3
6	Transition, turbulence	3
7	Turbulent boundary layers, turbulence models	3
8	Mid term	3
9	Turbulence and Applications to CFD: DNS and LES	3

	Scaling, decompositions, turbulence equations; scale representations, Direct and Large-Eddy Simulation; modeling; pseudo-spectral methods;	
10	Turbulence and Applications to CFD: RANS Second of two courses: Scaling, decomposition, turbulence equations; Reynolds Averaged Navier Stokes (RANS) modeling; phenomenological models	3
11	Computational Methods for Shear Layers Study of numerical solution methods for steady and unsteady laminar or turbulent boundary-layer equations in two and three dimensions	3
12	Computational Methods in Transonic Flow Numerical solution of partial differential equations of mixed type, with emphasis on transonic flows and separating boundary layers.	3
13	Compressible FLOW Two-dimensional subsonic flow; similarity rules; theory of characteristics; supersonic and hypersonic flows; nonsteady flow; oblique shock waves	3
14	Oral Exam.	3
15	Final Exam	3

4- Course Matrix

ILO's code number	Teaching/learning methods and strategies	Assessment methods and strategies
2.1.1 2.1.2 2.1.3 2.1.4 2.1.5 2.1.7	Formal lectures	Individual coursework assignments, quizzes, oral discussions and reports. Mid-term and /or final written examination is given.
2.2.2 2.2.4 2.2.5 2.2.6 2.2.7, 2.2.10 , 2.2.11	Analysis and problem-solving skills are developed through tutorial/problem sheets and small group exercises.	Analysis and problem-solving skills are assessed through oral and written examinations.
2.3.2 2.3.3, 2.3.5, 2.3.8	Virtual experiments demonstrations	Coursework exercises and reports, project reports and presentations.
2.4.2 2.4.3 2.4.5 2.4.6 2.4.8	Those skills are not explicitly taught; however, along the course of study the student will acquire those skills to be able to perform his obligations. Attendance of seminars, workshops or conferences will help the student	Project presentation

	in developing those skills. Presentation by students (either group or individual) will train students for those skills.	

5-Assessment schedule

Assessment 1	Assignments	on weeks	1, 3, 6
Assessment 2	Quizzes	on weeks	2, 4, 9, 13
Assessment 3	Mid-term exam	on weeks	8
Assessment 3	Oral exam	on week	14
Assessment 4	Final exam	on week	15

6- Weighting of assessments

20% (60 marks) Home assignments, Quizzes, and reports
20% (60 marks) Mid-term examination and Oral examination
60% (180 marks) Final-term examination
100% (300 marks) Total

7- List of References

7.1 Essential books (Text books)

Boundary Layer Theory. By Schlichting, H.
ASME transaction, Journal of Fluids Engineering.
Advanced Fluid Mechanics by W. P. Graebel (Jul 5, 2007)

7.2 Recommended books; Periodicals & Websites.

-Engineering Fluid Mechanics by W. P. Graebel (Jan 19, 2001)
-www.4shared.com
-yahoo group mail

8- Facilities required for teaching and learning

Presentation board, computer and data show
Laboratory

Course coordinator: Prof. Dr. Mohamed Fayek, Prof. Dr. Samir Sobhy

Course instructor: Prof. Dr. Mohamed Fayek, Prof. Dr. Samir Sobhy

Head of Department: Prof. Dr. Osama Ezzat

Matrix of course content and ILO's

Course Title: **Selected Topics in Fluid Dynamics** **Code**: **MEP702** **Lecture**: 3.
Tutorial: ---- **Practical**: ---- **Total:** 3
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Course content	ILO's A	ILO's B	ILO's C	ILO's D
Navier-Stoke's equations	a1	b1		
Some exact solutions of Navier-Stoke's equation	a2	b3	c1	
Experiments in fluid mechanics	a1, a3			
Term paper seminar	a1	b1, b6	c4	
Continuation of boundary layers, stability	a3	b3		
Transition, turbulence	a1			
Turbulent boundary layers, turbulence models	a2,a5			
One of the following topics is selected by the academic adviser according the candidate research point:				
Turbulence and Applications to CFD: DNS and LES Scaling, decompositions, turbulence equations; scale representations, Direct and Large-Eddy Simulation;	a3,a6	b3,b4		d1,d5
Turbulence and Applications to CFD: RANS Second of two courses: Scaling, decomposition, turbulence equations; (RANS) modeling	a3	b1,b7		
Computational Methods for Shear Layers Study of numerical solution methods for steady and unsteady laminar or turbulent boundary-layer equations	a2, a3	b1,b5	c1,c2,c3	
Computational Methods in Transonic Flow Numerical solution of partial differential equations of mixed type, with emphasis on transonic flows	a1,a4			d3
Compressible FLOW Two-dimensional subsonic flow; similarity rules; theory of characteristics; supersonic and hypersonic flows;	a3	b1, b2	c1	

Matrix of course aims and ILO's

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Course aims	ILO's A	ILO's B	ILO's C	ILO's D
1- Know the most general equations governing fluid flow.	a1 , a2 , a3		c3	
2- Analysis different turbulence models and computational codes.		b1 , b3	c1,c3,c4	d4
3- Master the boundary layer theory in both laminar and turbulent flows with transition theory.	a1	b3	c4	d3
4- Know experimental methods in fluid research.	a2	b2	c4	d2