2- Course Specification of Advanced Hydraulics

Course Code (CE543)

III. General Information About the Course:

13.	**Course Title:**	**Advanced Hydraulics**			
14.	**Course Code and Number:**	**CE543**			
15.	**Credit Hours:**	**Credit Hours**			**Total**
		Lecture	Practical	Seminar/Tutorial	
		2	----	2	3
16.	**Study Level and Semester:**	1st semester – MSc. Program			
17.	**Pre-requisites (if any):**	Hydraulics Engineering			
18.	**Co-requisites (if any):**	None			
19.	**Program (s) in which the course is offered:**	MSc. In Civil Engineering Program – Water and Environmental Engineering			
20.	**Language of teaching the course:**	English			
21.	**Study System:**	Courses			
22.	**Prepared By:**	Dr. Adnan Moharam			
23.	**Reviewed by:**	Dr. Mansour Haidrah			
24.	**Date of Approval:**				

IV. Course Description:

Advanced Hydraulics course develop understanding the fluid mechanics principles to analyze, design and construct open channel and closed conduit systems.

This course focus on the advance topics in hydraulics and employs theories of continuity, momentum, and energy equations to solve problems involving hydraulic jump, specific energy, critical depth, and water surface profiles of gradually and rapidly varied unsteady flow in open channels, in addition solve complex technical problems of unsteady flow in pipelines.

III. Course Intended Learning Outcomes (CILOs):

Upon successful completion of Advanced Hydraulics Course, the graduates will be able to:

a.1.1 Identify the discharge in open channels have simple and compound cross sections.

a.1.2 Define specific energy, occurrence of critical depth and hydraulic jump in open channels.

a.1.3 Describe the advanced hydraulic theories in non-uniform and unsteady flow in open channels.

a.2.1 Identify standard energy approaches and formulas of water surface profiles for gradually and rapidly varied unsteady flow.

a.2.2 Define the continuity, momentum and energy equations for unsteady flow in pipelines.

a3. Explain the non-uniform and unsteady flow problems occur in pipelines.

b1. Inspect and categorize water surface profiles for gradually and rapidly varied unsteady flows.

b2. Evaluate water hammer problem and other unsteady flow problems in pipelines.

b3. Apply the concept of specific energy to solve problems involving critical depth.

b4. Determine the best hydraulic sections and design earthen and lined open channels.

c1.	Analyze open channel flow problems and design open channels using modern software.
c2.	Solve complex technical problems of unsteady flow in pipelines.
c4.	Prepare design project of earthen and lined open channels.
d1.	Conduct thesis in hydraulic engineering to achieve the engineering solutions.
d2.	Work effectively within the team and use the rules of practice and professional ethics in hydraulic applications.
d3.	Conduct and discuss scientific researches/technical reports in hydraulic engineering to achieve engineering solutions and their impact on society and environment.

XII. Alignment of Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs)

CILOs		PILOs
e. Knowledge and Understanding: Upon successful completion of **the Advanced Hydraulics Course** , the graduates will be able to:		**E. Knowledge and Understanding:** Upon successful completion of the **MSc. in Water and Environmental Engineering Program**, the graduates will be able to:
a.1.1	Identify the discharge in open channels have simple and compound cross sections.	**A1.** Demonstrate in-depth understanding of the theory and practice of modern water and environmental systems identification, design and operation.
a.1.2	Define specific energy, occurrence of critical depth and hydraulic jump in open channels.	
a.1.3	Describe the advanced hydraulic theories in non-uniform and unsteady flow in open channels.	
a.2.1	Identify standard energy approaches and formulas of water surface profiles for gradually and rapidly varied unsteady flow.	**A2.** Demonstrate understanding of methodology, research planning, and analysis techniques.
a.2.2	Define the continuity, momentum and energy equations for unsteady flow in pipelines.	
a3.	Explain the non-uniform and unsteady flow problems occur in pipelines.	**A3.** Explain in details the key considerations and challenges of sustainable development of modern water and environmental systems.
f. Cognitive/ Intellectual Skills: Upon successful completion of **the Advanced Hydraulics Course,** the graduates will be able to:		**F. Cognitive/ Intellectual Skills:** Upon successful completion of the **MSc. in Water and Environmental Engineering Program**, the graduates will be able to:
b1.	Inspect and categorize water surface profiles for gradually and rapidly varied unsteady flows.	**B1.** Identify, formulate and solve complex Water and Environmental Engineering by selecting and applying appropriate tools and techniques.
b2.	Evaluate water hammer problem and other unsteady flow problems in pipelines.	**B2.** Critically review the scientific literature for effective justification and support of results and decisions.

b3.	Apply the concept of specific energy to solve problems involving critical depth.	**B3.** Select appropriate techniques and tools for successful problem solving.
b4.	Determine the best hydraulic sections and design earthen and lined open channels.	**B4.** Adopt appropriate methodologies, techniques and tools for analysis and evaluate of Water and Environmental Engineering systems.
g. Professional and Practical Skills: Upon successful completion of **the Advanced Hydraulics Course,** the graduates will be able to:		**G. Professional and Practical Skills:** Upon successful completion of the **MSc. in Water and Environmental Engineering Program**, the graduates will be able to:
c1.	Analyze open channel flow problems and design open channels using modern software.	**C1.** Apply modern tools for research, analysis, and design of modern systems.
c2.	Solve complex technical problems of unsteady flow in pipelines.	**C2.** Apply tools and techniques within the interdisciplinary nature to solve complex technical problems.
c3.		**C3.** Employ design standards and safety codes as an integral part of Water and Environmental process.
c4.	Prepare design project of earthen and lined open channels.	**C4.** Develop, conduct, defined and disseminate academic research or project in one of the Water and Environmental Engineering areas.
h. Transferable Skills: Upon successful completion of **the Advanced Hydraulics Course,** the graduates will be able to:		**H. Transferable Skills:** Upon successful completion of the **MSc. in Water and Environmental Engineering Program**, the graduates will be able to:
d1.	Conduct thesis in hydraulic engineering to achieve the engineering solutions.	**D1.** Prepare, present and defined a thesis.
d2.	Work effectively within the team and use the rules of practice and professional ethics in hydraulic applications.	**D2.** Incorporate professional with ethical responsibilities including contemporary issues and environmental awareness.
d3.	Conduct and discuss scientific researches/technical reports in hydraulic engineering to achieve engineering solutions and their impact on society and environment.	**D3.** Conduct research and communicate to advance knowledge in related fields.

XIII. Alignment of CILOs to Teaching and Assessment Strategies

e. Alignment of Knowledge and Understanding CILOs:

Knowledge and Understanding CILOs	Teaching Strategies	Assessment Strategies

a.1.1	Identify the discharge in open channels have simple and compound cross sections.	▪ Lectures ▪ Seminars ▪ Self-Learning ▪ Problems studies ▪ Case study ▪ Active learning	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
a.1.2	Define specific energy, occurrence of critical depth and hydraulic jump in open channels.	▪ Lectures ▪ Seminars ▪ Self-Learning ▪ Problems studies ▪ Case study ▪ Active learning	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
a.1.3	Describe the advanced hydraulic theories in non-uniform and unsteady flow in open channels.	▪ Lectures ▪ Seminars ▪ Self-Learning ▪ Problems studies ▪ Case study ▪ Active learning	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
a.2.1	Identify standard energy approaches and formulas of water surface profiles of gradually and rapidly varied unsteady flow.	▪ Lectures ▪ Seminars ▪ Self-Learning ▪ Problems studies ▪ Case study ▪ Active learning	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
a.2.2	Define the continuity, momentum and energy equations for unsteady flow in pipelines.	▪ Lectures ▪ Seminars ▪ Self-Learning ▪ Problems studies ▪ Case study ▪ Active learning	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
a3.	Explain the non-uniform and unsteady flow problems occur in pipelines.	▪ Lectures ▪ Seminars ▪ Self-Learning ▪ Problems studies ▪ Case study ▪ Active learning	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation

f. Alignment of Intellectual Skills CILOs:

Intellectual Skills CILOs		Teaching Strategies	Assessment Strategies
b1.	Inspect and categorize water surface profiles for gradually and rapidly varied unsteady flows.	▪ Lectures ▪ Self-Learning ▪ Case Study ▪ Simulation Exercises ▪ Independent Study ▪ Analysis and Problem Solving ▪ Brainstorming ▪ Presentations	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation

b2.	Evaluate water hammer problem and other unsteady flow problems in pipelines.	▪ Lectures ▪ Self-Learning ▪ Case Study ▪ Simulation Exercises ▪ Independent Study ▪ Analysis and Problem Solving ▪ Brainstorming ▪ Presentations	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
b3.	Apply the concept of specific energy to solve problems involving critical depth.	▪ Lectures ▪ Self-Learning ▪ Case Study ▪ Simulation Exercises ▪ Independent Study ▪ Analysis and Problem Solving ▪ Brainstorming ▪ Presentations	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
b4.	Determine the best hydraulic sections and design earthen and lined open channels.	▪ Lectures ▪ Self-Learning ▪ Case Study ▪ Simulation Exercises ▪ Analysis and Problem Solving ▪ Group/Individual Projects ▪ Brainstorming ▪ Presentations	▪ Written exam ▪ Written assignment ▪ Quizzes ▪ Student presentation
g. Alignment of Professional and Practical Skills CILOs:			
Professional and Practical Skills CILOs		**Teaching Strategies**	**Assessment Strategies**
c1.	Analyze open channel flow problems and design open channels using modern software.	▪ Lectures ▪ Self-Learning ▪ Case Study ▪ Simulation Exercises ▪ Independent Study ▪ Analysis and Problem Solving ▪ Brainstorming ▪ Presentations	▪ Written exam ▪ Seminar Report ▪ Written Research Proposal ▪ Student presentation
c2.	Solve complex technical problems of unsteady flow in pipelines.	▪ Lectures ▪ Self-Learning ▪ Case Study ▪ Simulation Exercises ▪ Independent Study ▪ Analysis and Problem Solving ▪ Brainstorming ▪ Presentations	▪ Written exam ▪ Seminar Report ▪ Written Research Proposal ▪ Student presentation

c4.	Prepare design project of earthen and lined open channels.	▪ Lectures ▪ Dissertation Defenses and Presentation ▪ Independent Study ▪ Presentation ▪ Brainstorming ▪ Group/Individual Projects ▪ Presenting Researches	▪ Seminar Report ▪ Written exam ▪ Seminar Report ▪ Project evaluation ▪ Student presentation

h. Alignment of Transferable (General) Skills CILOs:

Transferable (General) Skills CILOs		Teaching Strategies	Assessment Strategies
d1.	Conduct thesis in hydraulic engineering to achieve the engineering solutions.	▪ Dissertation Defenses and Presentation ▪ Independent Study ▪ Presentation ▪ Brainstorming ▪ Project ▪ Presenting Researches	▪ Written Research Proposal and Thesis ▪ Student presentation ▪ Written Report ▪ Project evaluation
d2.	Work effectively within the team and use the rules of practice and professional ethics in hydraulic applications.	▪ Dissertation Defenses and Presentation ▪ Independent Study ▪ Presentation ▪ Brainstorming ▪ Project ▪ Presenting Researches	▪ Written Research Proposal. ▪ Student presentation ▪ Written Report ▪ Project evaluation
d3.	Conduct and discuss scientific researches/technical reports in hydraulic engineering to achieve engineering solutions and their impact on society and environment.	▪ Dissertation Defenses and Presentation ▪ Independent Study ▪ Presentation ▪ Brainstorming ▪ Project ▪ Presenting Researches	▪ Written Research Proposal. ▪ Student presentation ▪ Written Report ▪ Project evaluation

XIV. Course Content

2. Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours	Course ILOs
1	**Open-Channel Flow**	▪ Introduction in open channel flow + Discharge in simple and compound channels.	1	3	**a.1.1, d1., d3.**
2		▪ The best efficiency cross-section for different shapes of channels.	2	3	**b1., b4., c1., c4., d2.**
3		▪ Design of earthen and lined channels.	3	3	
4		▪ Specific energy, critical depth and Hydraulic jump.	4	3	**a.1.2, b3., d1., d3.**
5		▪ Gradually varied unsteady flow.	5	3	**a.2.1, b1., d1., d3.**
6		▪ Rapidly varied unsteady flow.	6	3	

7	**Midterm exam**		7	3	
8	**Open-Channel Flow**	▪ Non-uniform and unsteady flow in channels (Structure of characteristics upstream and downstream of the gate and Riemann invariants).	8	3	**a.1.3, a3., d1., d3.**
9	**Pipe Flow**	▪ Continuity, momentum and Energy equations for unsteady flow.	9	3	**a.2.2, c2., d1., d3.**
10		▪ Non- uniform and unsteady flow in pipes for incompressibility fluids.	10	3	**c2., d1., d3.**
11		▪ Pressure wave celerities in pipelines + Water hammer in pipelines.	11	3	**b2., c2., d1., d3.**
12		▪ Instantaneous and rapidly closures of valves in pipelines	12	3	**c2., d1., d3.**
13		▪ Reservoir evacuation and pipe networks	13	3	**c2., d1., d3.**
14	**Final exam**		14	3	
Number of Weeks /and Contact Hours Per Semester					

2. Tutorial Aspect:

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Discharge in simple and compound channels	2	2	**a.1.1, d1., d3.**
2	The best efficiency section for different shapes of channels	3	2	**b1., b4., c1., c4., d2.**
3	Design of earthen and lined channels	4	2	**b1., b4., c1., c4., d2.**
4	Specific energy, critical depth and Hydraulic jump	5	2	**a.1.2, b3., c1., d1., d3.**
5	Gradually varied flow in open channels	6	2	**a.2.1, d1., d3.**
6	Rapidly varied flow in open channels	7	2	**a.2.1, d1., d3.**
7	Structure of characteristics upstream and downstream of the gate and Riemann invariants	9	2	**a.1.3, d1., d3.**
8	Continuity, momentum and energy equations of unsteady flow	10	2	**a.2.2, d1., d3.**
9	Pressure wave celerities in pipelines + Water hammer in pipelines.	11	2	**a3., b2., d1., d3.**
10	Instantaneous and rapidly closures of valves in pipelines	12	2	**c2., d1., d3.**
11	Reservoir evacuation and pipe networks	13	2	**c2., d1., d3.**
Number of Weeks /and Units Per Semester		**11**	**22**	

3 - Practical Aspect:

Order	Tasks	Number of Weeks	contact hours	Learning Outcomes

Number of Weeks /and Units Per Semester				

XV. Teaching Strategies:

- Discussion
- Cooperative learning
- Demonstration
- Lectures
- Self-Learning
- Simulation Exercises
- Independent Study
- Analysis and Problem Solving
- Brainstorming
- Dissertation Defenses and Presentation
- Presenting Researches
- Group/Individual Projects
- Presentations

XVI. Assessment Methods of the Course:

- Written exam
- Written assignment
- Quizzes
- Student presentation
- Written Research Proposal and Thesis
- Project evaluation

XVII. Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due	CILOs (symbols)
1	**Assignment 1:** Discharge in simple and compound channels + The best efficiency section for different shapes of channels	Individual	15 %	Week 3	**a.1.1, b1., b4., c1., c4., d2.**
2	**Project 1:** Design of earthen and lined channels + Specific energy, critical depth and Hydraulic jump.	Individual	15 %	Week 5	**a.1.2, b1., b3., b4., c1., c4., d2.**
3	**Assignment 2:** Gradually varied flow in open channels + Rapidly varied flow in open channels	Individual	15 %	Week 7	**a.2.1, d1., d3**
4	**Assignment 3:** Structure of characteristics upstream and downstream of the gate and Riemann invariants.	Individual	15 %	Week 9	**a.1.3, d1., d3**
5	**Assignment 4:** Continuity, momentum and energy equations for unsteady flow	Individual	10 %	Week 10	**a.2.2, d1., d3.**
6	**Assignment 5:** Pressure wave celerities in pipelines + Water hammer in pipelines.	Individual	15 %	Week 12	**a3., b2., d1., d3.**

7	**Assignment 6:** Instantaneous and rapidly closures of valves in pipelines + Reservoir evacuation and pipe networks	Individual	15 %	Week 14	**c2, d1., d3.**
	Total Score		**100 %**		

XVIII. Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment	CILOs
1	**Tasks and Assignments**	Weeks 3, 8, 12	10	10 %	**a.1.1, a.1.2, a.1.3, a.2.1, a.2.2, a3., b1., b2., b3., b4., c1., c2., c4., d1., d2., d3.**
2	**Quizzes**	Two times randomly	5	5 %	**a.1.1, a.1.2, a.1.3, a.2.1, a.2.2, a3., b1., b2., b3. b4., c1., c2., c4., d1., d2., d3.**
3	**Project**	Week 9	5	5 %	**a.1.1, a.1.2, a.1.3, a.2.1, a.2.2, a3., b1., b2., b3. b4., c1., c2., c4., d1., d2., d3.**
4	**Midterm Exam**	Week 8	20	20 %	**a.1.1, a.1.2, a.1.3, a.2.1, a.2.2, a3., b1., b3., b4., c1., c2., c4., d1., d2., d3.**
5	**Participation and attendance**	All lectures	10	10 %	**a.1.1, a.1.2, a.1.3, a.2.1, a.2.2, a3., b1., b2., b4., c1., c2., c4., d1., d2., d3.**
6	**Final Exam**	Week 16	50	50 %	**a.1.2, a.1.3, a.2.1, a.2.2, a3., b1., b2., b3., b4., c1., c2., c4., d1., d2., d3.**
Total			**100**	**100%**	

XIX. Learning Resources :

2. Required Textbook(s) :

1. Robert L. Daugherty and Joseph B. Franzini (1985). "Fluid Mechanics with Engineering Applications". Arabic Edition, McGraw-Hill Book Company, Cairo, Egypt.
2. Ven Te Chow (2009), ' Open-Channel Hydraulics", International Student Edition, McGraw-Hill International Book Company, Tokyo, Japan.

3. Essential References:

4. Vennard, J.K. and Street, R.L. (1995), Elementary Fluid Mechanics", Seventh Edition, John Wiley and Sons, New York, USA
5. Victor L. Streeter and E. Benjamin Wylie (1998), Fluid Mechanics", Ninth Edition, McGraw-Hill Book Company, New York, USA
6. Featherstone, R.E. and Nalluri C. (2007), "Civil Engineering Hydraulics, Backwell Science Limited", Fifth Edition, London, England

4. Electronic Materials and Web Sites *etc.*

None

XII . الضوابط والسياسات المتبعة في المقرر Course Policies

بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:

1	**سياسة حضور الفعاليات التعليمية Class Attendance:**

	- يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك. - يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.
2	**الحضور المتأخر Tardy:** - يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.
3	**ضوابط الامتحان Exam Attendance/Punctuality:** - لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان - إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.
4	**التعيينات والمشاريع Assignments & Projects:** - يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها. - إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.
5	**الغش Cheating:** - في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب. - في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.
6	**الانتحال Plagiarism:** – في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك
7	**سياسات أخرى Other policies:** - أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ

Academic Year: ……....

Course Plan (Syllabus): Advanced Hydraulics

V. Information about Faculty Member Responsible for the Course:

Name		**Office Hours**						
Location &Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**	
E-mail								

V. General information about the course:

10	**Course Title**	**Advanced Hydraulics**			
11	**Course Code and Number**	**CE543**			
12	**Credit Hours**	**Credit Hours**			**Total**
		Lecture	**Practical**	**Seminar/Tutorial**	
		2	--	2	**3**
13	**Study Level and Semester**	1st semester – MSc. Program			
14	**Pre-requisites**	Hydraulics Engineering			
15	**Co –requisite**	None			
16	**Program (s) in which the course is offered**	MSc. In Civil Engineering Program – Water and Environmental Engineering			
17	**Language of teaching the course**	English			
18	**Location of teaching the course**	Faculty of Engineering – Sana'a University			

VI. Course Description:

Advanced Hydraulics course develop understanding the fluid mechanics principles to analyze, design and construct open channel and closed conduit systems.

This course focus on the advance topics in hydraulics and employs theories of continuity, momentum, and energy equations to solve problems involving hydraulic jump, specific energy , critical depth, and water surface profiles of gradually and rapidly varied unsteady flow in open channels, in addition solve complex technical problems of unsteady flow in pipelines.

IV. Course Intended Learning Outcomes (CILOs):

Upon successful completion of Advanced Hydraulics Course, the graduates will be able to:

a.1.1 Identify the discharge in open channels have simple and compound cross sections.

a.1.2 Define specific energy, occurrence of critical depth and hydraulic jump in open channels.

a.1.3 Describe the advanced hydraulic theories in non-uniform and unsteady flow in open channels.

a.2.1 Identify standard energy approaches and formulas of water surface profiles for gradually and rapidly varied unsteady flow.

a.2.2 Define the continuity, momentum and energy equations for unsteady flow in pipelines.

a3. Explain the unsteady flow problems occur in pipelines.

b1.	Inspect and categorize water surface profiles for gradually and rapidly varied unsteady flows.
b2.	Evaluate water hammer problem and other unsteady flow problems in pipelines.
b3.	Apply the concept of specific energy to solve problems involving critical depth.
b4.	Determine the best hydraulic sections and design earthen and lined open channels.
c1.	Analyze open channel flow problems and design open channels using modern software.
c2.	Solve complex technical problems of unsteady flow in pipelines.
c4.	Prepare design project of earthen and lined open channels.
d1.	Conduct thesis in hydraulic engineering to achieve the engineering solutions.
d2.	Work effectively within the team and use the rules of practice and professional ethics in hydraulic applications.
d3.	Conduct and discuss scientific researches/technical reports in hydraulic engineering to achieve engineering solutions and their impact on society and environment.

V. Course Content

1. Theoretical Aspect

Order	Topic List / Units	Sub -Topics	Number of Weeks	Contact Hours
1	Open-Channel Flow	▪ Introduction in open channel flow + Discharge in simple and compound channels.	1	3
2		▪ The best efficiency cross-section for different shapes of channels.	2	3
3		▪ Design of earthen and lined channels.	3	3
4		▪ Specific energy, critical depth and Hydraulic jump.	4	3
5		▪ Gradually varied unsteady flow.	5	3
6		▪ Rapidly varied unsteady flow.	6	3
7	**Midterm exam**		7	3
8	Open-Channel Flow	▪ Non-uniform and unsteady flow in channels (Structure of characteristics upstream and downstream of the gate and Riemann invariants)	8	3
9	Pipe Flow	▪ Continuity, momentum and Energy equations for unsteady flow	9	3
10		▪ Non-uniform and unsteady flow in pipes for incompressibility fluids.	10	3
11		▪ Pressure wave celerities in pipelines + Water hammer in pipelines.	11	3
12		▪ Instantaneous and rapidly closures of valves in pipelines	12	3
13		▪ Reservoir evacuation and pipe networks	13	3
14	**Final exam**		14	3

Number of Weeks /and Contact Hours Per Semester		

2. Tutorial Aspect:			
No.	**Tutorial**	**Number of Weeks**	**Contact Hours**
1	Discharge in simple and compound channels	2	2
2	The best efficiency section for different shapes of channels	3	2
3	Design of earthen and lined channels	4	2
4	Specific energy, critical depth and Hydraulic jump	5	2
5	Gradually varied flow in open channels	6	2
6	Rapid varied flow in open channels	7	2
7	Structure of characteristics upstream and downstream of the gate and Riemann invariants	9	2
8	Continuity, momentum and Energy equations of unsteady flow	10	2
9	Pressure wave celerities in pipelines + Water hammer in pipelines.	11	2
10	Instantaneous and rapidly closures of valves in pipelines	12	2
11	Reservoir evacuation and pipe networks	13	2
Number of Weeks /and Units Per Semester		**11**	**22**

3 - Practical Aspect:				
Order	Tasks	Number of Weeks	contact hours	Learning Outcomes
Number of Weeks /and Units Per Semester				

VI. Teaching Strategies:

- Discussion
- Cooperative learning
- Demonstration
- Lectures
- Self-Learning
- Simulation Exercises
- Independent Study
- Analysis and Problem Solving
- Brainstorming
- Dissertation Defenses and Presentation
- Presenting Researches
- Group/Individual Projects
- Presentations

VII. Assessment Methods of the Course:

- Written exam
- Written assignment
- Quizzes
- Student presentation
- Written Research Proposal and Thesis
- Project evaluation

VI. Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due
1	**Assignment 1:** Discharge in simple and compound channels + The best efficiency section for different shapes of channels	Individual	15 %	Week 3
2	**Project 1:** Design of earthen and lined channels + Specific energy, critical depth and hydraulic jump	Individual	15 %	Week 5
3	**Assignment 2:** Gradually varied flow in open channels + Rapidly varied flow in open channels	Individual	15 %	Week 7
4	**Assignment 3:** Structure of characteristics upstream and downstream of the gate and Riemann invariants	Individual	15 %	Week 9
5	**Assignment 4:** Continuity, momentum and Bernoulli equations of unsteady flow	Individual	10 %	Week 10
6	**Assignment 5:** Pressure wave celerities in pipelines + Water hammer in pipelines.	Individual	15 %	Week 12
7	**Assignment 6:** Instantaneous and rapid closures of valves in pipelines + Reservoir evacuation and pipe networks	Individual	15 %	Week 14
	Total Score		**100%**	

VII. Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment
1	**Tasks and Assignments**	Weeks 3, 8, 12	10	10 %
2	**Quizzes**	Two times randomly	5	5 %
3	**Project**	Week 9	5	5 %
4	**Midterm Exam**	Week 8	20	20 %
5	**Participation and attendance**	All lectures	10	10 %
6	**Final Exam**	Week 16	50	50 %
Total			**100**	**100%**

X. Learning Resources :

3. Required Textbook(s) :

1. Robert L. Daugherty and Joseph B. Franzini (1985). "Fluid Mechanics with Engineering Applications". Arabic Edition, McGraw-Hill Book Company, Cairo, Egypt.
2. Ven Te Chow (2009), ' Open-Channel Hydraulics", International Student Edition, McGraw-Hill International Book Company, Tokyo, Japan.

4. Essential References:

1. Vennard, J.K. and Street, R.L. (1995), Elementary Fluid Mechanics", Seventh Edition, John Wiley and Sons, New York, USA
2. Victor L. Streeter and E. Benjamin Wylie (1998), Fluid Mechanics", Ninth Edition, McGraw-Hill Book Company, New York, USA
3. Featherstone, R.E. and Nalluri C. (2007), "Civil Engineering Hydraulics, Backwell Science Limited", Fifth Edition, London, England

3. Electronic Materials and Web Sites *etc.*

None

XI . الضوابط والسياسات المتبعة في المقرر Course Policies

بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:

1	**سياسة حضور الفعاليات التعليمية Class Attendance:** - **يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك.** - **يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.**
2	**الحضور المتأخر Tardy:** - **يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.**
3	**ضوابط الامتحان Exam Attendance/Punctuality:** - **لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان** - **إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.**

4	**التعيينات والمشاريع Assignments & Projects:** - يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها. - إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.
5	**الغش Cheating:** - في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب. - في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.
6	**الانتحال Plagiarism:** – في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك
7	**سياسات أخرى Other policies:** - أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ