



39 Course Specification of Hydraulic

I. Course Identification and General Information:					
1	Course Title:	<i>Hydraulics</i>			
2	Course Code & Number:	CE 210			
3	Credit hours:	C.H			Credit Hours
		Th.	Tu.	Pr.	Tr.
		2	2	2	
4	Study level/ semester at which this course is offered:	3 th Level/ 2 nd semester			
5	Pre –requisite (if any):	Fluid Mechanics			
6	Co –requisite (if any):	-----			
8	Program (s) in which the course is offered:	Civil Engineering			
9	Language of teaching the course:	English+ Arabic			
10	Location of teaching the course:	Class room and laboratory			
11	Prepared By:	Dr. Mansour Haidera & Dr. Zamzam Mubarak			
12	Date of Approval				

II. Course Description:
<p>The course includes types of flow in pipeline systems, characteristics and the flow governing equations for each type of flow , analysis and design of pipeline systems, types of pumps, pump characteristic curve and system curve, pump sizing, cavitation phenomenon, types of flow in open channels, analyses and design of various types of open channels under uniform flow condition; gradual varied flow (GVF)- rapid flow and their applications in open channels - flow measurements in open channel flow ,and the water surface profiles for GVF.</p>

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III. Course Intended learning outcomes (CILOs) of the course		Reference PILOs
a.1	Define the basic types of flow in pipes and the governing equations	A1
a.2	Describe the procedures for analyzing and the design of various types of pipeline systems including or excluding hydraulic machines	A2
a.3	Describe the various types of flow in open channels, the analysis and the design of channels with uniform flow	A2
a.4	Describe the behavior and procedures of pipe line system, types of flow in open channel by using each tools of related machine in hydraulic laboratory.	A5
b.1	Analyze flow problems to distinguish between basic types of flow in pipeline systems	B1
b.2	Choose the appropriate procedures for analyzing problems of designing various types of pipeline systems manually	B2
b.3	Choose the appropriate procedures for analyzing problems of designing channels with uniform flow manually.	B2
b.4	Consider the economic, social and environment issues in the design and the selection of pumps and the design of open channel	B4
c.1	Solve the problems of designing various types of pipe line systems and the design of open channel	C2
c.2	Analyze the data of the experiment to validate the types of flow in pipes	C1
c.3	Analyze the data of the experiment to validate the various types of flow in open channels	C1
c.4	Apply the techniques and software in solving problems and in the design of pipe line system, and the design of open channel.	C3
d.1	Write laboratory experiment report including the calculations, drawing and comments.	D1

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(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1- Define the basic types of flow in pipes and the governing equations.	Lecture Multimedia Presentations Tutorial Reading	Problem set- Written exam- Written assignment
a2- Describe the procedures for analyzing and design of various types of pipeline systems including or excluding hydraulic machines.	Lecture Multimedia Presentations Tutorial Reading	Problem set- Written exam- Written assignment
a3- Describe the various types of flow in open channels then analyze and design of channels with uniform flow.	Lecture Multimedia Presentations Tutorial Reading	Problem set- Written exam- Written assignment
a4- Describe the behavior and procedures of pipe line system, types of flow in open channel by using each tools of related machine in hydraulic laboratory	Lecture Multimedia Presentations, and Visiting to machine in Laboratory. Reading	Problem set- Written exam- Written assignment-

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1- Analyze flow problems to distinguish between basic types of flow in pipeline systems.	Lecture Multimedia Presentations Tutorial Reading	Participation- Written assignment- Written exam
b2- Choose the appropriate procedures for analyzing problems of designing various types of pipeline systems manually.	Lecture Multimedia Presentations Tutorial Reading Discussion and demonstration	Participation- Written assignment- project- Written exam

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(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b3- Choose the appropriate procedures for analyzing problems of designing channels with uniform flow manually.	Lecture Multimedia Presentations Tutorial Reading	Problem set- Written exam- Written assignment
b4- Consider the economic, social and environment issues in the design and the selection of pumps and the design of open channel	Lecture Multimedia Presentations Tutorial Reading	Problem set- Written exam- Written assignment

C Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1- Solve the problems of designing various types of pipe line systems and the design of open channel	Lecture Presentations Tutorial	Problem set- Written exam- Written assignment
c2- Analyze the data of the experiment to validate the types of flow in pipes.	Laboratory Experiments Demonstration and discussion Small group working	Laboratory performance, individual and group work, Written exam.
c3- Analyze the data of the experiment to validate the various types of flow in open channels.	Laboratory Experiments Demonstration and discussion Small group working	Laboratory performance, individual and group work, Written exam
c4- Apply the techniques and software in solving problems and in the design of pipe line system, and the design of open channel.	Presentation Tutorial /Small project- Individual/small group working	Written assignment

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
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d.1 Write laboratory experiment report including calculations, drawing and comments.	Lab experiments	Written report of each laboratory experiment
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IV. Course Content:					
A – Theoretical Aspect:					
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	Revision on Bernoulli equation for real flow and flow measurements	a1, a4	Velocity measurement–flow measurement.	1	2
2	Types of flow	a1, a4, b1, b2	Laminar and turbulent flow- Flow losses in pipes: friction losses and secondary losses -Energy line and Hydraulic gradient line (HGL)	2	4
3	Velocity distribution in laminar and turbulent flows	a1, a4, b1, b2	At different depth of pipe section	1	2
4	Pipe connection systems	a2, a4, b2	pipes in parallel –pipes in series-branched pipes-pipe's network and analysis (Hardy Cross method)	2	4
5	Network analysis using a computer software	a2, a4, b2	For pipe's network (Darcy-Weisbach formula, Hazen William formula or Chezy formula)	1	2
6	Network analysis using a computer software	a2, a4, b2	For pipe's network (Darcy-Weisbach formula, Hazen William formula or Chezy formula)	1	2
7	Hydraulic machines	a2, a4, b2, b4,	Types of Hydro- machines-pumps - characteristics curve for pumps - cavitation in pumps –pump	2	4

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IV. Course Content:					
A – Theoretical Aspect:					
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
			selection and installation: pumps in parallel and in series		
8	Flow in open channels	a3, a4, b3	flow equations –flow classification - uniform flow - natural depth (uniform depth flow)	1	2
9	Open channels design	a3, a4, b3, b4	single lined and unlined channel-compound channels and the most economic section.	1	2
10	Specific energy - critical depth - applications on specific energy of open channel	a3, a4, b3,	At different sections along channel length	1	2
11	Gradual variable flow-rapid flow - practical applications	a3, a4, b3,	With open gate, different slope and presence of step (different sections)	1	2
Number of Weeks /and Units Per Semester				14	28

B -Tutorial Aspect:				
Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	Revision on Bernoulli equation and its application/flow and velocity measurements	1	2	a1, a4
2	Types of flow/flow losses in pipes: friction and secondary losses	2	4	b1, b2, c1
3	Velocity distribution in laminar and turbulent flows	1	2	b1, b2, c1
4	Pipe connection systems	2	4	b2, c1,
5	Network analysis using a computer software	2	4	b2, c1, c4

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6	Hydro machines	1	2	b2, b4, c1, c4
7	Flow in open channels	1	2	b3, c1,
8	Open channels design	1	4	b3, b4-c1, c4
9	Specific energy - critical depth - applications on specific energy	1	2	b3,-c1
10	Gradual variable flow- rapid flow - practical applications	1	2	b3, c1,
11	Review and receiving the last assignment/ small project	1	2	b1, b2, b3, b4.c1, c4
Number of Weeks /and Units Per Semester		14	28	

C – Practical Aspect:				
Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	Revision on Bernoulli equation and its application/flow and velocity measurements, weir and flow through orifice	3	6	a1, a4, d1
2	Types of flow/flow losses in pipes: friction and secondary losses	3	6	b1, b2, c2, d1
3	Pipe connection systems: Parallel and series	2	4	c2, d1
4	Flow in open channels: Specific energy - critical depth - applications on specific energy (determination of flow characteristic on rock bed, determination of flow characteristic on sharp weir. determination of flow characteristic on rectangular weir)	2	4	c3, d1
5	Flow in open channels: Gradual variable flow- rapid flow - practical applications (flow under gate, hydraulic jump)	2	4	c2
6	Review and receiving the last report	2	4	a2, a4, b1, b2, c2, c3, d1

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Number of Weeks /and Units Per Semester	14	28	
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V. Teaching strategies and tools of the course:

Lecture
Multimedia Presentations
Presentations
Tutorial and discussion
Reading
Lab experiments (Hydraulic machine and instruments)
Using a computer software analyzing a water-network and open channel.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Revision on Bernoulli equation and flow measurements:	a1, a4, d1	1	1
2	Types of flow	a1, a4, b1, b2, c1, d1	2-3	1
3	Velocity distribution in laminar and turbulent flows	a1, a4, b1, b2, c1	4	1
4	Pipe connection systems	a2, a4, b2, c1, d1	5-6	1
5	Network analysis using a computer software	a2, a4, b2, c1, c4	7-8	1
6	Hydro machines	a2, a4, b2, b4, c1, c4,	9-10	1
7	Flow in open channels	a3, a4, b3, c1, d1	11	1
8	Open channels design	a3, a4, b3, b4-c1, d1	12	1
9	Specific energy - critical depth - applications on specific energy	a3, a4, b3,-c1, d1	13	1
10	Gradual variable flow- rapid flow - practical applications	a3, a4, b3,-c1, d1	14	1

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VII. Reports:				
No	Assignments	Aligned CILOs(symbols)	Week Due	Mar k
1	Revision on Bernoulli equation and its application/flow and velocity measurements, weir and flow through orifice	a1, a4, d1	3	2
2	Types of flow/flow losses in pipes: friction and secondary losses	b1, b2, c2, d1	3	2
3	Pipe connection systems: Parallel and series	c2, d1	2	1.5
4	Flow in open channels: Specific energy - critical depth - applications on specific energy (determination of flow characteristic on rock bed, determination of flow characteristic on sharp weir. determination of flow characteristic on rectangular weir)	c3, d1	2	1.5
5	Flow in open channels: Gradual variable flow- rapid flow - practical applications (flow under gate, hydraulic jump)	c2	2	1.5
6	Review and receiving the last report	a2, a4, b1, b2, c2, c3, d1	2	1.5

VIII. Schedule of Assessment Tasks for Students during the Semester:					
No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Written assignment	1-2-3-4-5-6-7-8-9-10-11-12-13-14	10	5%	b1, b2, b3, b4, c1, c4
2	Quizzes.	Three time randomly	10	5%	b1, b2, b3, b4, c1
	reports	3,6,8,10,12,14	10	5%	a2, a4, b1, b2, c2, c3, d1

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3	Mid-term exam.	7 th	30	15%	a1, a2, a3, b1, b2, b3, C1, C4
4	Practical Exam.,	15 th	20	10%	c2, c3, d1
5	Final-exam.	16 th	120	60%	a1, a2, a3, b1, b2, b3, C1, C4
	Sum		200	100%	

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IX. Learning Resources:	
<ul style="list-style-type: none"> Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher). 	
1- Required Textbook(s) (maximum two).	
	1- Roberson, J. A., Cassidy J. J., Chaudhry, M. H., (1997), "Hydraulic Engineering", 2nd edition, John Wiley & sons, inc. 2-R.E. Featherstone and C.Nalluri (1995) "Civil Engineering Hydraulics", 3 rd Ed., by Blackwell Science. 3- MODI, P.N. and SETH, S.M. "Hydraulic s and Fluid Mechanics "
2- Essential References.	
	1- Lecture notes. 2- Subramanya, K. (1982), Flow in Open Channels, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 7th reprint 1992.
3- Electronic Materials and Web Sites etc.	

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X. Course Policies:	
1	Class Attendance: The students should have more than 75 % of attendance according to rules and regulations of the faculty.
2	Tardy: The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.
3	Exam Attendance/Punctuality: The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4	Assignments & Projects: The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
5	Cheating: If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for investigation and punishment according to the faculty rules.
6	Plagiarism: The student will be terminated from the Faculty, if one student attend the exam on another behalf according to the policy, rules and regulations of the university.
7	Other policies: - All the teaching materials should be kept out the examination hall. - The mobile phone is not allowed. - There should be a respect between the student and his teacher.

Reviewed By	<u>Vice Dean for Academic Affairs and Post Graduate Studies</u> <u>Dr. Tarek A. Barakat</u> <u>Dr. Mohammad Algorafi</u>
	<u>Deputy Rector for Academic Affairs Dr. Ibrahim AlMutaa</u> <u>Dr. Ahmed mujahed</u> <u>Dr. Munaser Alsubri</u>

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Course Plan (Syllabus) of Hydraulic

I. Information about Faculty Member Responsible for the Course:								
Name of Faculty Members	Dr. Mansour Haidera & Dr. Zamzam Mubarak		Office Hours					
Location& Telephone No.	Civil Engineering Department/733333016/77422 9900		SA T	SUN	MO N	TU E	W ED	TH U
E-mail	mhaidera@hotmail.com Zamzam-mubarak@yahoo.com			8-10				

II. Course Identification and General Information:						
1-	Course Title:	Hydraulics				
2-	Course Number & Code:	CE210				
3-	Credit hours:	C.H				Credit Hours
		Th.	Tu.	Pr.	Tr.	
		2	2	2		
4-	Study level/year at which this course is offered:	3th Level/ 2 nd semester				
5-	Pre –requisite (if any):	Fluid Mechanics				
6-	Co –requisite (if any):	-----				
7-	Program (s) in which the course is offered	Civil Engineering				
8-	Language of teaching the course:	English+ Arabic				
9-	System of Study:	Regular				
10-	Mode of delivery:	Lecture/Multimedia presentation				
11-	Location of teaching the course:	Class, Laboratory				

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III. Course Description:

The course includes types of flow in pipeline systems, characteristics and the flow governing equations for each type of flow, analysis and design of pipeline systems, types of pumps, pump characteristic curve and system curve, pump sizing, cavitation phenomenon, types of flow in open channels, analyses and design of various types of open channels under uniform flow condition; gradual varied flow (GVF)- rapid flow and their applications in open channels - flow measurements in open channel flow, and the water surface profiles for GVF.

IV. Intended learning outcomes (ILOs) of the course:

• Brief summary of the knowledge or skill the course is intended to develop:

- a1-** Define the basic types of flow in pipes and the governing equations (A1)
- a2-** Describe the procedures for analyzing and the design of various types of pipeline systems including or excluding hydraulic machines (A2)
- a3-** Describe the various types of flow in open channels, the analysis and the design of channels with uniform flow (A2)
- a4-** Describe the behavior and procedures of pipe line system, types of flow in open channel by using each tools of related machine in hydraulic laboratory. (A5)
- b1-** Analyze flow problems to distinguish between basic types of flow in pipeline systems (B1)
- b2-** Choose the appropriate procedures for analyzing problems of designing various types of pipeline systems manually (B2)
- b3-** Choose the appropriate procedures for analyzing problems of designing channels with uniform flow manually. (B2)
- b4-** Consider the economic, social and environment issues in the design and the selection of pumps and the design of open channel (B4)
- c1-** Solve the problems of designing various types of pipe line systems and the design of open channel (C2)
- c2-** Analyze the data of the experiment to validate the types of flow in pipes (C1)
- c3-** Analyze the data of the experiment to validate the various types of flow in open channels (C1)
- c4-** Apply the techniques and software in solving problems and in the design of pipe line system, and the design of open channel. (C3)
- d1-** Write laboratory experiment report including the calculations, drawing and comments. (D1)

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A – Theoretical Aspect:				
Order	Topics List	Sub Topics List	Week Due	contact hours
1	Revision on Bernoulli equation and flow measurements	Velocity measurement–flow measurement.	1	2
2	Types of flow	Laminar and turbulent flow- Flow losses in pipes: friction losses and secondary losses -Energy line and Hydraulic gradient line (HGL)	2,3	4
3	Velocity distribution in laminar and turbulent flows	At different depth of pipe section	4	2
4	Pipe connection systems	pipes in parallel –pipes in series- branched pipes-pipe’s network and analysis (Hardy Cross method)	5,6	2
5	Network analysis using a computer software	For pipe’s network (Darcy-Weisbach formula, Hazen William formula or Chezy formula)	7	2
6	Midterm Exam		8	2
7	Network analysis using a computer software	For pipe’s network (Darcy-Weisbach formula, Hazen William formula or Chezy formula)	9	2
8	Hydraulic machines	Types of Hydro- machines-pumps - characteristics curve for pumps - cavitation in pumps –pump selection and installation: pumps in parallel and in series	10,11	4
9	Flow in open channels	flow equations –flow classification - uniform flow - natural depth (uniform depth flow)	12	2
10	Open channels design	single lined and unlined channel- compound channels and the most economic section.	13	2
11	Specific energy - critical depth - applications on specific energy	At different sections along channel length	14	2
12	Gradual variable flow- rapid flow - practical applications	With open gate, different slope and presence of step (different sections)	15	2
13	Final Exam		16	2

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V. Course Content:				
A – Theoretical Aspect:				
Order	Topics List	Sub Topics List	Week Due	contact hours
Number of Weeks /and Units Per Semester			16	32

B –Tutorial Aspect:			
Order	Tasks/ Experiments	Week Due	contact hours
1	Revision on Bernoulli equation and its application/flow and velocity measurements	1	2
2	Types of flow/flow losses in pipes: friction and secondary losses	2-3	4
3	Velocity distribution in laminar and turbulent flows	4	2
4	Pipe connection systems	5,6	4
5	Network analysis using a computer software	7,8	4
6	Hydro machines	9	2
7	Flow in open channels	10	2
8	Open channels design	11	2
9	Specific energy - critical depth - applications on specific energy	12	2
10	Gradual variable flow- rapid flow - practical applications	13	2
11	Review and receiving the last report	14	2
Number of Weeks /and Units Per Semester		14	28

C – Practical Aspect:			
Order	Tasks/ Experiments	Week due	contact hours
1	Revision on Bernoulli equation and its application/flow and velocity measurements, weir and flow through orifice	1,2,3	6
2	Types of flow/flow losses in pipes: friction and secondary losses	4,5,6	6
3	Pipe connection systems: Parallel and series	7,8	4
4	Flow in open channels: Specific energy - critical depth - applications on specific energy	9,10	4

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	(determination of flow characteristic on rock bed, determination of flow characteristic on sharp weir. determination of flow characteristic on rectangular weir)		
5	Flow in open channels: Gradual variable flow- rapid flow - practical applications (flow under gate, hydraulic jump)	11,12	4
6	Review and receiving the last report	13,14	4
Number of Weeks /and Units Per Semester		14	28

VI. Teaching strategies of the course:

Lecture
Multimedia Presentations
Presentations
Tutorial and discussion
Reading
Hydraulic machine and instruments
Using a computer software analyzing a water-network

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Revision on Bernoulli equation and flow measurements:	a1, a4, d1	1	1
2	Types of flow	a1, a4, b1, b2, c1, d1	2-3	1
3	Velocity distribution in laminar and turbulent flows	a1, a4, b1, b2, c1	4	1
4	Pipe connection systems	a2, a4, b2, c1, d1	5-6	1
5	Network analysis using a computer software	a2, a4, b2, c1, c4	7-8	1
6	Hydro machines	a2, a4, b2, b4, c1, c4,	9-10	1
7	Flow in open channels	a3, a4, b3, c1, d1	11	1
8	Open channels design	a3, a4, b3, b4, c1, d1	12	1

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9	Specific energy - critical depth - applications on specific energy	a3, a4, b3, c1, d1	13	1
10	Gradual variable flow- rapid flow - practical applications	a3, a4, b3, c1, d1	14	1

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VIII. REPORTS:				
No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Revision on Bernoulli equation and its application/flow and velocity measurements, weir and flow through orifice	a1, a4, d1	1-3	2
2	Types of flow/flow losses in pipes: friction and secondary losses	b1, b2, c2, d1	4-6	2
3	Pipe connection systems: Parallel and series	c2, d1	7-8	1.5
4	Flow in open channels: Specific energy - critical depth - applications on specific energy (determination of flow characteristic on rock bed, determination of flow characteristic on sharp weir. determination of flow characteristic on rectangular weir)	c3, d1	9-10	1.5
5	Flow in open channels: Gradual variable flow- rapid flow - practical applications (flow under gate, hydraulic jump)	c2	11-12	1.5
6	Review and receiving the last report	a2, a4, b1, b2, c2, c3, d1	13-14	1.5

IV. Schedule of Assessment Tasks for Students During the Semester:				
No.	Type of Assessment Tasks	Week Due	Mark	Proportion of Final Assessment
1	Written assignment	1-2-3-4-5-6-7-8-9-10-11-12-13-14	10	5%
2	Quizzes.	Three time randomly	10	5%
3	reports	3,6,8,10,12,14	10	5%
4	Mid-term exam.	7 th	30	15%
5	Practical Exam.,	15 th	20	10%
6	Final-exam.	16 th	120	60%
7	Sum		200	100%

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IX. Learning Resources:	
<ul style="list-style-type: none"> Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher). 	
1- Required Textbook(s) (maximum two).	
	1- Roberson, J. A., Cassidy J. J., Chaudhry, M. H., (1997), "Hydraulic Engineering", 2nd edition, John Wiley & sons, inc. 2-R.E. Featherstone and C.Nalluri (1995) “Civil Engineering Hydraulics”,3 rd Ed., by Blackwell Science. 3- MODI, P.N. and SETH, S.M. "Hydraulic s and Fluid Mechanics "
2- Essential References.	
	1- Lecture notes. 2- Subramanya, K. (1982), Flow in Open Channels, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 7th reprint 1992.
3- Electronic Materials and Web Sites etc.	

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X. Course Policies:	
1	Class Attendance: The students should have more than 75 % of attendance according to rules and regulations of the faculty.
2	Tardy: The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.
3	Exam Attendance/Punctuality: The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4	Assignments & Projects: The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
5	Cheating: If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for investigation and punishment according to the faculty rules.
6	Plagiarism: The student will be terminated from the Faculty, if one student attend the exam on another behalf according to the policy, rules and regulations of the university.
7	Other policies: - All the teaching materials should be kept out the examination hall. - The mobile phone is not allowed. - There should be a respect between the student and his teacher.

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