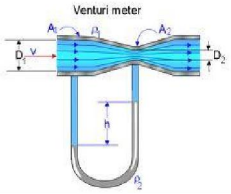	Course Title: HYDRAULICS		
	Credits (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15CE41T**
	Type of Course Delivery: **Lectures and Student activity**	**Credit :4**	Core/ Elective: **Core**
CIE- 25 Marks			SEE- 100 Marks

(*(Common to all Civil/Civil (Draughtsman/Environmental/Public Health Engineering/Water Technology and Health Sciences Programme)*****

Prerequisites: **Engineering Mathematics and Applied Science**

Course Objectives

1. Understand the principles and properties of fluid under static and dynamic state.
2. Measurement and computation of discharge of water.
3. Introduction to hydraulic machines.

At the end of the course the students should be able to

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Define the terminology related to fluid properties, pressure and its measurements and compute forces on immersed vertical plane surfaces.	***R/U/Ap***	1,2,3,4,5,6	**10**
CO2	Apply the hydraulic principles in solving problems on discharge and pressure measurements using flow measuring devices. To analyse the forces and its head.	***R/U/Ap***	1,2,3,4,5,6	**10**
CO3	Determine the discharge and coefficients of discharge for Notches, Orifices and Weirs.	***R/U/Ap***	1,2,3,4,5,6	**13**
CO4	Verify the flow parameters related to pipes to measure the various losses of head through pipes.	***R/U/Ap***	1,2,3,4,5,6	**07**
C05	Analyse the flow parameters related to channels and to design most economical channel sections and also to measure the discharge.	***R/U/Ap***	1,2,3,4,5,6	**08**
C06	Summarize the principles of pumps and Turbines.	***R/U***	1,2,3,4,5,6	**04**

C07	Manage the suggested or identified problems on hydraulics and solve in teams, in order to improve future problem solving ability and able to present it.	**R/U/Ap/Ay/C**	1 to 10	*
		Total sessions		**52**

Legend- R: Remember U: Understand Ap: Application Ay: Analysis C: Creation E: Evaluation

*** Related to Student activity beyond classroom hours.**

Programme outcome Attainment Matrix

Course	Programme Outcome									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
	Basic knowledge	Discipline knowledge	Experiments and Practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Life long learning
Hydraulics	3	3	3	3	3	3	1	1	1	1

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

DETAILED COURSE CONTENTS

UNITS	CONTENT	HOURS
1	**FLUIDS, PRESSURE & ITS MEASUREMENTS AND HYDROSTATICS** **Fluid**-definition, types and properties (simple problems). **Pressure and its measurements**-Definition of fluid pressure, intensity of pressure and pressure head, Pascal's law, atmospheric pressure, gauge pressure, absolute pressure, vacuum pressure and their relations, Measurement of pressure: Piezometer, Manometer, differential manometer, (simple problems). **Hydrostatics**-Total pressure and centre of pressure on vertical planes like, triangular , rectangular and circular plane surfaces (simple problems).	**10**
2	**FLOW OF FLUIDS** Definition of discharge, Types of flow and their comparison, uniform and non-uniform flow, steady and unsteady flow, stream line and turbulent flow, rotational and irrotational flow, compressible and incompressible flow. Continuity equation- simple problems. Energies in fluid motion and their heads- Potential, Kinetic and Pressure head Bernoulli's theorem (without proof), assumptions and its limitations–simple problems. Horizontal venturimeter, theory and simple problems.	**10**
3	**FLOW THROUGH ORIFICES, NOTCHES AND WEIRS.** Definition, types of orifices, vena contracta, hydraulic co-efficient and their relationship (simple problems), Flow through only circular orifice (simple problems without derivation), Definition and types of mouthpiece (only theory). Definition of notch, and its types, discharge calculation for rectangular, triangular and trapezoidal notch (simple problems without derivation). Definition of weir, types, discharge over rectangular and cippolitte weir (simple problems without derivation)	**13**
4	**FLOW THROUGH PIPES** Loss of fluid friction, Types of losses-major and minor losses, Darcy's and Chezy's formula for head loss due to friction (simple problems). Hydraulic gradient and Total Energy Line. Flow through single pipe, Flow from one reservoir to another reservoir through single pipe, (simple problems). Water hammer, surge tanks (only theory).	**07**
5	**FLOW THROUGH CHANNELS** Definition and classification of channels. Discharge through channels using Chezy's and Manning's formula (no derivation – simple problems only). Most economical sections for rectangular and trapezoidal channels (simple problems).	**08**
6	**PUMPS AND TURBINES** Working principle of Reciprocating and centrifugal pumps (Only Theory) Turbine, types and its working principle of Pelton and Francis turbine (Only Theory)	**04**
	Total	**52**

Course Delivery: The course will be delivered through lectures and Power point presentations/ Video.

SUGGESTED ACTIVITIES

The topic should be related to the course in order to enhance his knowledge, practical skill & and lifelong learning, communication, modern tool usage.

1. Prepare/Download a dynamic animation to illustrate the following:
2. Working principle of hydraulic pumps.

3. Working of different types of hydraulic devices (applications).
4. Download the catalogue of Hydraulic devices.
5. Arrange visit to nearby Hydraulic equipment based industries.
6. To visit an industry and submit a report on pressure measuring devices.
7. To prepare a report on pressure measuring devices available in market with its specifications
8. To carryout market survey for pipes of different sizes and materials available.
9. To visit & submit a report on nearby canal/irrigation structures/dam site to know the usage of notches and weirs.
10. To assess conditions of water supply mains of your locality and quantify the damages and remedial measures to be taken.
11. Types of pumps available in market and its uses.
12. Hydrological aspects of drought in your district
13. Hydrological aspects of small hydels in western ghats
14. Hydrological status of a few tanks in and around district a study using gis and remote sensing
15. Proposed mini hydel project near by your locality
16. Hydraulic floor crane, hydraulic four wheel jack, hydro power, hydraulic car lift, water wheel, hydraulic regenerative braking system

NOTE:

1. Students should select any one of the above or other topics relevant to the subject approved by the concerned faculty, individually or in a group of 3 to 5. Students should mandatorily submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics. Weightage for 5 marks Internal Assessment shall be as follows:
Unsatisfactory **1**, Developing **2**, Satisfactory **3**, Good **4**, Exemplary **5**.

2. Reports should be made available along with bluebooks to IA verification officer

Example of model of rubrics / criteria for assessing student activity

Dimension	**Students score (Group of five students)**				
	STUDENT 1	STUDENT 2	STUDENT 3	STUDENT 4	STUDENT 5
Rubric Scale	Unsatisfactory **1**, Developing **2**, Satisfactory **3**, Good **4**, Exemplary5				
1.Literature	3				
2.Fulfill team's roles & duties	2				
3.Conclusion	4				
4.Convensions	5				
Total	14				
Average=(Total /4)	3.5=4				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity to attain last CO (course outcome) may be given to a group of FIVE students					

Note: Dimension should be chosen related to activity and evaluated by the course faculty.

Dimension	Rubric Scale				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary
1.Literature	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles
3.Communication	Poor	Less Effective	Partially effective	Effective	Most Effective
4.Convensions	Frequent Error	More Error	Some Error	Occasional Error	No Error

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)		Max Marks	Evidence collected	Course outcomes
Direct Assessment meth	CIE	IA	Students	Thrice test (Average of three tests)	Test 1	20	Blue books	CO1, CO2
					Test 2			CO3, CO4
					Test 3			CO5, CO6
				Student Activities		05	Written Report	CO7
	SEE	End Exam		End of the course		100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course			Feedback forms	1,2 & 3 Delivery of course
	End of Course Survey			End of the course			Questionnaires	1,2,3, 4,5, 6, 7 Effectiveness of Delivery of instructions & Assessment Methods

***CIE** – Continuous Internal Evaluation ***SEE** – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Questions for CIE and SEE will be designed to evaluate the various educational components such as:

1	Remembering and Understanding	48% weightage
2	Applying the knowledge acquired from the course	52% weightage
3	Analysis	0% weightage
4	Evaluation	0% weightage
5	Creating new knowledge	0% weightage

Weightage of Marks and blue print of marks for SEE

Unit	Major Topics	Hours Allotted	Questions to be set for SEE – Cognitive Levels R	U	Ap	Marks weightage	weightage (%)	A*	B*
1	Fluids, pressure & its measurements and hydrostatics	10	16.66% **5**	33.33% **10**	50.00% **15**	30	19	2	2
2	Flow of fluids	10	16.66% **5**	16.66% **5**	66.66% **20**	30	19	2	2
3	Flow through orifices, notches and weirs	13	13.00% **5**	28.57% **10**	57.14% **20**	35	25	1	3
4	Flow through pipes	7	25.00% **5**	25.00% **5**	50.00% **10**	20	13	2	1
5	Flow through channels	8	25.00% **5**	25.00% **5**	50.00% **10**	20	15	2	1
6	Pumps and turbines	4	50.00% **5**	50.00% **5**	0.00% **0**	10	8	0	1
	Total	52	**20.9%** **30**	**27.6%** **40**	**51.7 %** **75**	145	100	9	10

Legend- R; Remember U: Understand Ap: Application Ay: Analysis C: Creation E: Evaluation

A*-SEE questions to be set for (05 marks) in Part – A

B*- SEE questions to be set for (10 marks) in Part – B

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM		20
	Year:		
Name of Course coordinator : CO's:____			Units:__

Question no	Question	MARKS	CL	CO	PO
1					
2					
3					
4					

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

Model Question Paper for CIE :

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	IV SEM	Hydraulics	20
	Year: 2015-16	Course code:15CE41T	

Name of Course coordinator : **Course Outcome : 1,2**
Note: Answer all questions

Question		M	CL	CO	PO
1	1. State the different principles of measurement of pressure.	3	R	1	1,2,3
2	2. Differentiate between specific weight and specific gravity of an oil.	4	U	1	1,2,3
3	3. Define Bernoulli's theorem.	2	R	2	1,2,3,4
4	4. State the difference between uniform flow and non-uniform flow & steady and unsteady flow	4	U	2	1 to 6
5	a) A simple Manometer containing mercury is used to measure the pressure of water flowing in a pipe line. The mercury level in the open tube is 60mm higher than that in the left tube. If the height of water in the left tube is 500mm, determine the pressure in the pipe in terms of head of water. **OR** b) Water is flowing through a pipe of 100mm diameter with an average velocity of 10m/s. Determine the rate of discharge of the water in litres/salsa determine the velocity of water at the other end of the pipe, if the diameter of the pipe is gradually changed to 200mm.	7	A	1 ,2	1 to 6

TEXT BOOKS

1. Hydraulics and Fluid Mechanics - Dr. P.N.Modi and DrS.M.Seth
2. Hydraulics and Fluid Mechanics - Dr. JagadishLal
3. Hydraulics and Fluid Mechanics - Abdulla Sheriff
4. Hydraulics and Hydraulic Machinery V. Thanikachelam T.T.T.I Madras - 600 113
5. Hydraulics, Fluid Mechanics and Fluid Machines - S.Ramamrutham.
6. Hydraulics, Fluid Mechanics and Fluid Machines Bansal A R.
7. Hydraulics, Fluid Mechanics and Hydraulic Machines R S Khurmi

Model Question Paper

Diploma in Civil Engineering

4TH semester

Course title: **HYDRAULICS**

Time: 3Hrs. **Max. marks : 100**

Part –A

Answer any six questions each carries 5 marks

1. Distinguish between gauge pressure and absolute pressure.
2. What is Manometer? Explain differential manometer with a neat sketch.
3. Draw a neat sketch of Venturimeter and name the parts.
4. State the limitations of Bernoulli's theorem.

5. Define Hydraulic coefficients and give the relation between them.
6. List different major and minor losses in pipe flow.
7. What is water hammer?
8. Define most economical section & state the conditions for a rectangular channel.
9. Explain the term open channel & list the various types of open channels.

Part –B

Answer any seven each question carries 10 marks

1. a) Define Pressure head and Total Pressure.
   b) A rectangular tank 3mx4m in size contain water upto a depth of 2.5m. Calculate the total pressure on the base of the tank and also intensity of pressure at the base of the tank.

2. The right limb of a simple U-tube manometer containing mercury is open to the atmosphere, while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 120mm below the level of mercury in the right limb. Find the pressure of fluid in the pipe, if the difference of mercury level in the two limbs is 200mm.

3. a) State a Bernoulli's theorem.
   b) A pipe 300m long has a slope of 1 in 100 and tapers from 1.0m diameter at the higher end to 0.50m at the lower end. The quantity of water flowing is 900lit/sec. If the pressure at the higher end is 70KPa, find the pressure at the lower end.

4. A venturimeter with a 150mm diameter at inlet and 100mm at throat is laid with its axis horizontal and is used for measuring the flow of oil specific gravity 0.9. The oil mercury differential monometer shows a gauge difference of 200mm. Assume coefficient of the meter as 0.98. Calculate the discharge in litres per minute.

5. a) What is an orifice? Mention its different types.
   b) A jet of water issues from an orifice of diameter 20mm under a head of 1m.What is the 'Cd' for the orifice, if actual discharge is 0.85lit/sec?

6. a) List the advantages of a triangular notch over a rectangular notch.
   b) During an experiment in a laboratory, 280lit of water flowing over a right angled triangular notch was collected in one minute. If the head of water over the sill is 100mm, calculate the 'Cd' of the notch.

7. a) Differentiate between a notch and a weir.
   b) A Trapezoidal notch of 1.2m wide at top and 0.45m at bottom is 0.3m high. Find the discharge through notch if head over notch is 225mm.Take C_d=0.6

8. a) State Darcy's equation for determination of loss of head due to friction in pipe.
   b) A reservoir has been built 4km away from a new extension area having 5000 population. Water is to be supplied from the reservoir to the new extension area. It is estimated that each person will consume 200litres of water per day, and that half of the daily supply is pumped within 10hours.Calculate the size of the supply main, if the loss of head due to friction in the pipeline is 20m.Take co-efficient of friction for the pipe line is 0.008

9. a) Define most economical channel section.
   b) Calculate the bed slope of trapezoidal channel of bed width 9m,depth of flow 1.2m and side slope 2H to 1V if the discharge is 8 m^3/s and Chezy's constant C=50.

10. a) With a neat sketch explain the main parts of a Reciprocating pump.
    b) Write any five differences between impulse turbine and reaction turbine.

MODEL QUESTION BANK

CO I : Fluids, pressure & its measurements and hydrostatics

Cognitive level –Remember

1. What is meant by pressure head? Derive an expression for it.
2. State the different principles of measurement of pressure.
3. Define the density of a liquid.
4. Define atmospheric pressure, gauge pressure, absolute pressure.
5. What is Manometer? Mention types of manometer.
6. State the difference between simple and differential manometer.
7. Define total pressure, centre pressure.

Cognitive level -Understand

8. Distinguish between gauge pressure and absolute pressure
9. Differentiate between specific weight and specific gravity of an oil.
10. Distinguish between compressibility and capillarity of water.
11. What do you understand by the term intensity of pressure? State its units.

Cognitive level -Application

12. A simple Manometer containing mercury is used to measure the pressure of water flowing in a pipe line. The mercury level in the open tube is 60mm higher than that in the left tube. If the height of water in the left tube is 500mm, determine the pressure in the pipe in terms of head of water.
13. A differential Manometer connected at the two points A and B at the same level in a pipe containing an oil of specific gravity 0.85, shows a difference in mercury level as 150mm.Determine the difference in pressure at the two points, the level of mercury in the left limb is lower than that in the right limb.
14. Determine the total & centre of pressure on an isosceles triangular plate of base 4m and altitude 4m, when it is immersed vertically in an oil of Sp.Gr. 0.9.The base of the plate coincides with the free surface of oil.
15. Find the intensity of pressure on diver working, at a depth of 200m under the sea, if the specific gravity of sea water is 1.025.

CO II : Apply the hydraulic principles in solving problems on discharge and pressure measurements using flow measuring devices.

Cognitive level –Remember

1. Define Bernoulli's theorem.
2. Give the equation for continuity of flow.
3. State the limitations of Bernoulli's theorem.
4. 4.Draw a neat sketch of Ventuimeter and name the parts.

5. What is Venturimeter?

Cognitive level -Understand

6. State the difference between uniform flow and non uniform flow & steady and unsteady flow.

Cognitive level -Application

7. A circular pipe of 250mm diameter carries an oil of specific gravity 0.8 at the rate of 120lit/sec and under a pressure of 20kpa.Calculate the total energy in meters at point which is 3m above datum line.
8. Water is flowing through a pipe of 100mm diameter with an average velocity of 10m/s. Determine the rate of discharge of the water in litres/salsa determine the velocity of water at the other end of the pipe, if the diameter of the pipe is gradually changed to 200mm.
9. A venturimeter with a 150mm diameter at inlet and 100mm at throat is laid with its axis horizontal and is used for measuring the flow of oil specific gravity 0.9. The oil mercury differential monometer shows a gauge difference of 200mm.Assume coefficient of the meter as 0.98. Calculate the discharge in litres per minute.
10. A pipe 300m long has a slope of 1 in 100 and tapers from 1m at the higher end to 0.5m at the lower end. Discharge through pipe is 5400litre per minute, if pressure at the higher end is 70KN/m^2, find the pressure at the lower end.

CO III : Understand and able to determine the discharge and coefficients of discharge for Notches, Orifices and Weirs.

Cognitive level –Remember

1. Define veena contracta.
2. What is an orifice? Give the classification.
3. Define Hydraulic coefficients and give the relation between them.
4. List the types of notches.
5. List the advantages of a triangular notch over a rectangular notch.

Cognitive level -Understand

6. Differentiate between a notch and a weir.
7. What is a cipplottei weir? How does it differ from a rectangular weir?

Cognitive level -Application

8. A right angled V-notch was used to measure the discharge of a pump if the depth of water over the notch is 200mm,calculate the discharge if C_d=0.62.
9. A Trapezoidal notch of 1.2m wide at top and 0.45m at bottom is 0.3m high. Find the discharge through notch if head over notch is 225mm.Take C_d=0.6.
10. A weir, 8m long is to be built across a rectangular channel to discharge a flow of 9m^3/sec. If the maximum depth of water on the upstream side of the weir is limited to 2mts maximum, what must be the height of the weir? Take C_d=0.62.
11. A jet of water issues from an orifice of diameter 20mm under a head of 1m.What is the 'Cd' for the orifice, if actual discharge is 0.85lit/sec?

CO IV : Analyze the flow parameters related to pipes to measure the various losses of head through pipes.

Cognitive level –Remember

1. List the types of losses in the pipe flow.
2. Give the Darcy's formula for head loss due to friction.
3. What is water hammer?
4. What is hydraulic mean depth?

Cognitive level -Understand

5. Explain Hydraulic gradient line & Total energy line with neat sketch.
6. Explain the surge tank with sketch.

Cognitive level -Application

7. A town having a population of 100000 is to be supplied with water from a reservoir at 5km distance. It is stipulated that one half of the daily supply 150lts/head should be delivered within 8. Hour that must be the size of the pipe to furnish the supply, if head available is 12m and C=45.

CO V : Analyze the flow parameters related to channels and to design most economical channel sections and also to measure the discharge.

Cognitive level –Remember

1. Give the Chezy's formula and Manning's formula.
2. State the conditions of the most economical section of a rectangular and Trapezoidal channel.

Cognitive level –Understand

3. Explain the term open channel & list the various types of open channels.

Cognitive level -Application

4. A rectangular channel has a cross section of $50m^2$.Determine the discharge through the most economical section, if bed slope is 1 in 1000 take Chezy's constant C=52.5.

CO VI : Understand the principles of pumps and Turbines

Cognitive level –Remember

1. What are the different types of pumps?
2. What is a turbine?
3. How turbines are classified?

Cognitive level -Understand

4. Explain the working principle of a centrifugal pump with sketch.
5. Explain the working principle of a reciprocating pump with sketch.