

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM**

**HYDRAULICS  
(Code: 3330603)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Civil Engineering, Environmental Engineering, Transportation Engineering	3 <sup>rd</sup> semester

**1. RATIONALE**

It is necessary for civil, environmental and transportation engineers to understand the behavior of fluid flow in different conditions in pipes, channels, canals, notches, weirs etc. In the field these conditions are very common and diploma passouts has to solve problems related to water seepage and discharge.

The basic knowledge about hydraulics and fluid mechanics will be useful in subjects like Irrigation, Water Resources Management and Public Health Engineering. In this course, basics of hydraulics and its application oriented content has been kept with a focus that students should be able to solve practical problems. Competencies developed by this course would therefore be useful for students while performing his/her job in the field of Water resources / Irrigation/PHE and Environment Engineering.

**2. COMPETENCIES (Programme Outcomes as per NBA Terminology)**

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:

- i Measure the pressure and flow of water in different conditions using various measuring devices**
- ii Compute discharge and loss of head through pipes, open channels, notches and other hydraulic structures.**

**3. TEACHING AND EXAMINATION SCHEME**

<b>Teaching Scheme (In Hours)</b>			<b>Total Credits (L+T+P)</b>	<b>Examination Scheme</b>				
				<b>Theory Marks</b>		<b>Practical Marks</b>		<b>Total Marks</b>
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>ESE</b>	<b>PA</b>	<b>ESE</b>	<b>PA</b>	
3	1	2	6	70	30	20	30	<b>150</b>

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

#### 4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
<b>Unit – I Introduction, Pressure and pressure measurement</b>	1a.Explain the terms associated with Hydraulics 1b.Clarify different properties of liquid 1c. Describe different types of pressure and methods of measurement	1.1 Technical terms used in Hydraulics – Fluid Mechanics, Hydrostatics, Hydro-kinematics, Hydro-Dynamics-Ideal and Real Fluid. 1.2 Properties of liquid – Viscosity-Density-Specific Gravity-Surface Tension-Capillarity Vapour Pressure-Elasticity. 1.3 Various types of pressure – Atmospheric Pressure-Gauge Pressure-Absolute Pressure Vacuum Pressure-Separation Pressure/s 1.4 Measurement of pressure/s by different methods 1.5 Measurement of difference of pressure using “U” tube Manometer and inverted “U” tube Manometer
<b>Unit – II Hydrostatics</b>	2a Explain the Relationship between pressure and depth of liquid 2b.Compute total Pressure and Centre of pressure	2.1 Relationship between pressure and depth of liquid 2.1.1 Pressure diagram for different conditions 2.2 Total pressure and center of pressure 2.2.1 Computation of Total Pressure and depth of centre of pressure
<b>Unit – III Hydro kinematics &amp; Hydrodynamics</b>	3a. Explain different types of flow 3b. Derive Continuity Equation 3c. Explain different kinds of energy 3d Apply Bernoulli’s theorem to measure the pressure and Discharge.	3.1 Types of flow - Laminar --Turbulent --Uniform -- Non-uniform --Steady--Un-steady --Rotational and irrotational --One, Two and Three Dimensional flow 3.2 Reynold’s number 3.3 Continuity Equation 3.4 Types of Energy – Potential, Pressure and kinematics 3.5 Bernoulli’s Equation and its applications. 3.6 Momentum Equation
<b>Unit – IV Hydraulic coefficient, notches and weirs</b>	4a. Compute different Hydraulic Coefficient for different types of orifice 4b. Identify types of Notches and weirs. 4c. Calculate discharge through notches and weirs.	4.1 Definition and types of orifice 4.2 Various Hydraulic Coefficient and its relation - Coefficient of Contraction, Velocity, Discharge. 4.3 Types of notches and weirs 4.4 Computation of discharge through notches 4.4.1 Rectangular Notch 4.4.2 V -Notch. 4.5 Computation of discharge through weirs 4.5.1 Discharge through narrow crested and broad Crested weir. 4.5.2 Discharge through Cipolletti weir.
<b>Unit – V Flow through pipes</b>	5a. Explain Energy (Head) losses 5b. Draw Hydraulic Gradient Line (HGL) and Total Energy Line (TEL) 5c. Design Pipeline	5.1 Characteristics of flow through pipes 5.2 Major and Minor Energy (Head) losses in pipe Flow- frictional loss, loss of head at entry, exit, Sudden enlargement and contraction and at bend. 5.2.1 Computation of major head by Darcy Weisbach Equation. 5.3 Hydraulic Gradient Line (HGL) and Total Energy

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	network using formula and nomogram	Line (TEL) 5.4 Design of Pipeline-using formula & Nomogram
<b>Unit – VI</b> <b>Flow through Open Channel</b>	6a. Analyse uniform flow 6b. Understand Specific Energy Diagram 6c. Describe Procedure for measuring Velocity of flow 6d. Calculate discharge.	6.1 Characteristics of open channel flow 6.1.1 Comparison of pipe flow and channel flow. 6.1.2 Field examples of open channel 6.2 Analyse uniform flow 6.2.1 Froud's number, 6.2.2 Hydraulic mean depth- concept & computation 6.2.3 Use of Chezy's and Manning's formulae. 6.2.4 Most economical sections of channel 6.2.4.1 Rectangular, Trapezoidal and circular shapes. 6.3 Specific Energy Diagram 6.4 River Gauging 6.4.1 Measurement of mean velocity using surface float, velocity rod and current meter.

## 5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction, Pressure and pressure measurement	7	3	4	4	11
II	Hydrostatics	5	3	4	-	7
III	Hydro kinematics & Hydrodynamics	8	2	7	7	16
IV	Hydraulic coefficient, notches and weirs	8	2	5	7	14
V	Flow through pipes	7	3	4	4	11
VI	Flow through Open Channel	7	3	4	4	11
<b>Total</b>		<b>42</b>	<b>16</b>	<b>28</b>	<b>26</b>	<b>70</b>

**Legends:** R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## 6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (Course Outcomes in psychomotor and affective domain) so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

**Note:** Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of Programme Outcomes/Course Outcomes in affective domain as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA terminology)	Apprx. Hrs. Required
1	I	Measure the pressure of water in pipe using (a) Piezometer (b) Different types of manometers	4
2	III	Determine discharge through a given venturimeter.	4
3	IV	Determine coefficient such as $C_c$ , $C_v$ , and $C_d$ for different types of orifices	4
4	IV	Compute coefficient of discharge for V notch and Preparation of calibration graph for interpolation and extrapolation	4
5	IV	Compute coefficient of discharge for Rectangular notch and Preparation of calibration graph for interpolation and extrapolation	4
6	V	Determine loss of head in various diameter of pipes and effect of material of pipe on loss of head	4
7	III	Demonstrate functioning of Bernoulli's Apparatus	2
8	III	Demonstrate use of Reynold's number	2
		<b>Total</b>	<b>28</b>
<b>TUTORIALS</b>			
1	I	Solve numerical problems based Pressure measurement	2
2	II	Solve numerical problems based on Hydrostatics	2
3	III	Solve numerical problems based on Hydrodynamic and Hydro kinematics	4
4	IV	Solve numerical problems based on Hydraulic coefficient, notches and weirs	2
5	V	Solve numerical problems based on Flow through pipes	2
6	VI	Solve numerical problems based on Flow through Open Channel	2
		<b>Total</b>	<b>14</b>

## 7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

1. Student will visit nearby Canal Structure and Submit report consisting flow data, cross sections, hydraulic data etc. for the same.
2. Student will Survey an industry / Department for handling or using pressure measuring devices.

3. Student will carry out market survey for pipes of different materials.

### 8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Use demonstration, video/animation films field/industry visit for explaining complex/abstract concepts of Hydraulics.
- ii. This course requires lot of practice on numerical. Students may be asked to solve the numerical during lecture periods and tutorial periods, in addition home assignments may be given. To avoid copying by students each problem must have different parameters for each student or at least there may be five to six sets of problems with different values., In other words each student will get same problem but with varied parameters. (Values of pressure, volume, flow, force, distance, speed etc may be different for each student)

### 9. SUGGESTED LEARNING RESOURCES

#### (A) List of Books:

S. No.	Title of Books	Author	Publication
	Hydraulics, Fluid Mechanics and Hydraulic machine	S.Ramamrutham	Dhanpat Rai
	Hydraulics, Fluid Mechanics and Hydraulic machine	R. S. Khurmi	S.Chand
2	Hydraulics, Fluid Mechanics and Hydraulic machine	R K Bansal	S.Chand
3.			
4.	Fluid Mechanics	A K Jain	Khanna Publishers
5.	Journal of experiments in Hydraulics	Rao and Hasan	New Height
6.	Hydraulic laboratory	Rao and Hasan	New Height
7.	Fluid Mechanics	Dr.M.L.Mathur	Std.Publication
8	Fluid Mechanics & Hydraulics	S.C.Gupta	Pearson Education
9.	Hydraulics and Hydraulic machine	Prof.V.P.Priyani	Charotar Publication

#### B. List of Major Equipment/Materials

1. Piezometer
2. U-Tube Manometer
3. Venturimeter
4. V-notch
5. U-notch
6. Pipes- PVC, G.I.,
7. Measuring Tank
8. Stop Watch
9. Gauge
10. Mercury

Or Hydraulic Bench equipped with all above equipments

**C List of Software/Learning Websites**

- i. [www.waterbouw.tudelft.nl/](http://www.waterbouw.tudelft.nl/)
- ii. [www.learnrstv.com](http://www.learnrstv.com)
- iii. [www.shiksha.com](http://www.shiksha.com) , IIT, Roorkee
- iv. [www.blackwellpublishing.com](http://www.blackwellpublishing.com)
- v. [www.hrpwa.org](http://www.hrpwa.org)
- vi. [www.creativeworld9.com](http://www.creativeworld9.com)
- vii. [nptel.iitm.ac.in](http://nptel.iitm.ac.in)

**10. COURSE CURRICULUM DEVELOPMENT COMMITTEE****Faculty Members from Polytechnics**

- **Prof. P.A. Pandya**, Lecturer in Civil Engg. Deptt. – Govt. Polytechnic, Himatnagar
- **Prof. H. R. Mehta**, Lecturer in Civil Engg. Deptt. – C. U. Shah Polytechnic, Surendranagar
- **Prof. Anil K. Belani**, Lecturer in Civil Engg. Deptt. – Tolani F. G. Polytechnic, Adipur
- **Prof. Rina K. Chokshi**, Head, Civil Engg. Deptt. – Parul Institute of Engg. And Tech. (Diploma Studies), Limda, Vadodara.

**Coordinator and Faculty Members from NITTTR Bhopal**

- **Dr. A K JAIN** , Professor , Department of Civil & Environmental Engineering
- **Prof J. P. Tegar**, Professor and Head Department of Civil & Environmental Engineering