ANDHRA LOYOLA INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, New Delhi & Affiliated to JNTU-Kakinada)
An ISO 9001:2015 Certified Institution, A NAAC Accredited Institution
Vijayawada

DEPARTMENT OF CIVIL ENGINEERING

MICRO LESSON PLAN

A.Y.   : 2019-2020   **Class : II B.Tech I Semester**

Subject: Fluid Mechanics (R19)   **Faculty: G. Lenin Reddy**

Course Objectives:

1. To understand fluid properties, variation and measurement of Pressure

2. To derive equations of law of conservation of mass, energy, momentum and apply it to fluid kinematics and dynamics

3. To Apply Bernouli's equation to measure the discharge of the flow.

4. To analyze laminar and turbulent flows.
5. To study in detail about the boundary layer theory.

Course Outcomes:

Upon successful completion of this course you should be able to:

1. Understand the various properties of fluids and their influence on fluid motion and analyse a variety of problems in fluid statics and Calculate the forces that act on submerged planes and curves..
2. Understand and apply Continuity equation, Bernouli's equation and Impulse momentum equation

3.   Apply Bernouli's equation to measure the discharge of the flow.

4.   Determination of minor losses, major losses, HGL, TEL and studying the flow through pipe, parallel plates.

5. Understands and apply the concept of boundary theory for laminar, trasition, turbulent flow.

Course Outcomes:

S. No	Outcomes	Lesson Objectives
1	Factual	Students will get introduced to Fluid Mechanics
2	Conceptual	To identify concepts of mathematics, Physics/Science behind and Possess a good understanding of the Methods
3	Procedural	Students should be able to learn basic principles of Fluid Mechanics
4	Applied	Students can be able to get ease of understanding a problem principles in getting a solution

Detailed Text:
Lesson - 1 Introduction

S. No	Outcomes	Contents/Activities for Lesson - 1
1	Factual	Reading basic information
2	Conceptual	Relevant Examples, Video Lectures, Animations
3	Procedural	Concepts
4	Applied	Reading, Understanding & Solving problems

Schedule and Sequence: Day Plan for Lesson-1
Lesson: 1 Introduction

Session/ Module / Day	Topic	Objectives	Before Class (Videos, E-Books, Case Studies)	In Class (Activities, Quiz, Solving Problems)	Post Class (Assignment, Discussion Forum)
Day - 1	Units and Dimensions	To make students familiarize with units and dimensions	• Text Book	• Explanation with/without PPT (15 Min) • Unit conversions (10 Min) • Solving numerical on unit conversions (20 Min)	Quiz
Day - 2	Physical Propertie of fluids	To make the student understand mass density, weight density, specific volume,	• Text Book	• Explanation with/without PPT (25 Min) • Solving numerical (20 Min)	Quiz, Numericals

		specific gravity, Viscosity, Derivation of Newton's law of viscosity, Units of viscosity			
Day - 3	Effect of temperature on viscosity of fluids, Surface tension	To familiarize student with effect of temperature on viscosity, Concept of surface tension, derivation of expressions for excess pressure for water droplet, soap bubble, liquid jet in terms of surface tension	• Text Book	• Explanation with/without PPT (25 Min) • Solve Numerical (20 Min)	Numerical
Day - 4	Capillarity	To make understand concept of Capillarity, derivation of expression for capillary rise, depression, Applications of capillarity	• Text Book •	• Explanation with/without PPT (25 Min) • Solve Numerical on capillarity	Numerical
Day - 5	Vapour Pressure, Cavitation, Bulk modulus, Compressibility	To make the student gain knowledge & to know Vapour Pressure, Cavitation, Bulk modulus, Compressibility	• Text Book	• Explanation with/without PPT (25 Min) • Video (10 Min) • Quiz	Quiz on topics of Day 1 to Day 5
Day - 6	Hydrostatic pressure	To make the student gain knowledge & to know concept of Pressure, Pressure at a point, Pascal's law and its proof	• Text Book	• Explanation with/without PPT (25 Min) • Video (20 Min) • Student Creative Response (5 Min)	Queries

Day - 7	Hydrostatic pressure	To make the student gain derivation of variation of pressure in vertical direction only	• Text Book	• Explanation with chalk and talk (25 Min) • Solving numericals (20 Min)	Numericals
Day - 8	Hydrostatic pressure	To make the student understand the concept of Atmospheric pressure, Gage pressure, Absolute pressure and relation between them and simple Manometers	• Text Book	• Explanation with chalk and talk (25 Min) • Derivation of expression of pressure for U-tube manometer, Solving numericals (20 Min) • Student Creative Response (5 Min)	Solve Numericals
Day - 9	Hydrostatic pressure	To make the student gain knowledge & to know Single column manometer, Differential manometers	• Text Book	• Explanation with chalk and Talk the derivation of expression of pressures for single column manometer, U-tube manometer, Inverted U – tube manometer (25 Min) • Solving numerical on U-tube manometer (20 Min)	Solve Numerical
Day - 10	Hydrostatic pressure	To make the student gain knowledge & to know Micro manometers, Mechanical gages	• Text Book	• Explanation with/without PPT (25 Min) • Video (20 Min) • Student Creative Response (5 Min)	Queries
Day - 11	Hydrostatic forces, Centre of pressure of plane submerged surfaces	To make the student gain knowledge & to know Hydrostatic force, center of pressure	• Text Book	• Explanation with/without PPT definition of hydrostatic force, Centre of pressure (10 Min) • Derivation of expression for hydrostatic force, centre of pressure for horizontal,	Solve Numericals

				• vertical submerged areas (20 Min) • Solving Numerical (15 Min)	
Day - 12	**Hydrostatic forces, Centre of pressure of plane submerged surfaces**	**To make the student gain knowledge & to know Hydrostatic force, Centre of pressure on inclined submerged bodies**	• **Text Book**	• **Explanation with/without PPT** • **Derivation of expression for hydrostatic force, centre of pressure for horizontal, vertical submerged areas (30 Min)** • **Solving numerical (20 Min)** • **Student Creative Response(5 Min)**	**Solve Numerical**
Day - 13	**Hydrostatic forces, Centre of pressure of Curved submerged surfaces**	**To make the student gain knowledge & to know Hydrostatic force, center of pressure on curved submerged surfaces.**	• **Text Book**	• **Explanation with/without PPT (25 Min)** • **Solving numerical (20 Min)** • **Student Creative Response(5 Min)**	**Solve Numerical**

Schedule and Sequence: Day Plan for Lesson-2

Lesson: 2

Session/ Module / Day	Topic	Objectives	Before Class (Videos, E-Books, Case Studies)	In Class (Activities, Quiz, Solving Problems)	Post Class (Assignment, Discussion Forum)
Day - 1	Fluid Kinematics	To make the student gain knowledge & to know Velocity, acceleration Description of fluid flow, Classification of fluid flows	● Text Book	● Explanation with/without PPT (25 Min) ● Video (20 Min) ● Student Creative Response(5 Min)	Quiz Assignment on Velocity, acceleration
Day - 2	Fluid Kinematics	To make the student gain knowledge & to know Stream line, Streak line, path line, stream tube, Continuity equation	● Text Book	● Explanation with/without PPT (10 Min) ● Video (05 Min) ● Derivation of 3D continuity equation(25 Min)	Assignment on deducing 3D continuity equations for different conditions viz., Steady, Incompresssible, 2D
Day - 3	Fluid Kinematics	To make the student gain knowledge & to know Continuity equation of 1D flow	● Text Book	● Explanation with/without PPT (25 Min) ● Solving numerical on continuity equation (20 Min) ● Student Creative Response(5 Min)	Numericals on continuity equation
Day - 4	Fluid Kinematics	To make the student gain knowledge & to know Stream function, Velocity potential function, flownet and	● Text Book	● Explanation with/without PPT (25 Min) ● Derivation of proof of streamlines and equipotential lines are	Assignment on plotting of potential function, Stream function

		their uses		perpendicular to each other (20 Min)	
Day - 5	Fluid Dynamics	To make the student gain knowledge & to know Lagrange, Euler approach, Euler equation	● Text Book	● Explanation with/without PPT (10 Min) ● Derivation of Euler equation (35 Min)	QUIZ
Day - 6	Fluid Dynamics	To make the student gain knowledge & to know Bernouli's equation	● Text Book	● Explanation with/without PPT Derivation of Bernouli equation(35 Min) ● Solving Numerical on Bernouli's equation(15Min)	Solve Numericals on Bernouli's equation
Day - 7	Fluid Dynamics	To make the student gain knowledge & to know Bernouli's equation	● Text Book	● Explanation with/without PPT Derivation of Bernouli equation along a stream line (20 Min) ● Solving Numerical on Bernouli's equation(15Min)	Solve Numericals on Bernouli's equation
Day - 8	Fluid Dynamics	To make the student gain knowledge & to know Impulse momentum	● Text Book	● Explanation with/without PPT Derivation of Impulse momentum equation (40 Min) ● Application of Impulse momentum equation on pipe Bends (15Min)	Solve Numericals on Impulse momentum equation
Day - 8	Fluid Dynamics	To make the student gain knowledge & to know Impulse momentum	● Text Book	● Solving Numericals onapplication of Impulse momentum equation (50 Min)	Solve Numericals on Impulse momentum equation

Schedule and Sequence: Day Plan for Lesson-3
Lesson: 3

Session/ Module / Day	Topic	Objectives	Before Class (Videos, E-Books, Case Studies)	In Class (Activities, Quiz, Solving Problems)	Post Class (Assignment, Discussion Forum)
Day - 1	Venturimeter: Principle, derivation of expression for C_d	To make the student gain knowledge & to know Venturimeter: Principle, derivation of expression for C_d	• Text Book	• Explanation with/without PPT (20 Min) • Derivation (25 Min) • Student Creative Response (5 Min)	Derive the derivation of Cd on own
Day - 2	Expression for ' h' when venturimeter is horizontal, inclined, vertical, and also specific weight of manometric fluid, lesser, heavier than flowing fluid. Numerical on venturimeter	To make the student gain knowledge & to know expressions for 'h' in Qact for different cases	• Text Book	• Explanation with/without PPT (20 Min) • Numerical (25 Min) • Student Creative Response (5 Min)	To solve Numericals on Qact of Venturimeter
Day - 3	Orificemeter: Principle, derivation of expression for C_d	To make the student gain knowledge & to know orificemeter: Principle, derivation of expression for C_d	• Text Book	• Explanation with/without PPT (20 Min) • Derivation (25 Min) • Student Creative Response (5 Min)	Derive the derivation of Cd on own

Day - 3	**Nozzle meter of flow nozzle, Rotameter, Elbowmeter(pipe bend meter)**	**To make the student gain knowledge & to know Nozzle meter of flow nozzle, Rotameter, Elbowmeter(pipe bend meter)**	● **Text Book**	● **Explanation with/without PPT (25 Min)** ● **Numerical on venturimeter (20 Min)** ● **Student Creative Response (5 Min)**	**Solve numerical on orificemeter**
Day - 4	**Pitot tube: Principle, derivation of expression for velocity, expression for 'h'**	**To make the student gain knowledge & to know Pitot tube: Principle, derivation of expression for velocity, expression for 'h'**	● **Text Book**	● **Explanation with/without PPT (25 Min)** ● **Numerical on measurement of velocity with a pitot tube (20 Min)** ● **Student Creative Response (5 Min)**	**Numerical on measureme nt of velocity with a pitot tube**
Day - 5	**Classificatio n of orifices: Derivation of Toricelli formula, Coefficient of velocity C_v, Coefficient of contraction C_c, relation between C_v , C_c , C_d**	**To make the student gain knowledge & to know Classification of orifices: Derivation of Toricelli formula, Coefficient of velocity C_v, Coefficient of contraction C_c, relation between C_v , C_c , C_d**	● **Text Book**	● **Explanation with/without PPT (25 Min)** ● **Derivation of Toricelli formula (20 Min)** ● **Student Creative Response (5 Min)**	**Description of classificatio n of orifices on their own with neat labeled diagrams.**
Day - 6	**Experimen tal Determinat ion of coefficient of velocity Cv-Jet distance measureme**	**To make the student gain knowledge & to know Experiment al Determinati on of coefficient of velocity Cv**	● **Text Book**	● **Explanation with/without PPT (25 Min)** ● **Numerical on jet distance measurement method (20 Min)** ● **Student Creative**	**Different methods of determinati on of Cv**

				Response(5 Min)	
Day - 7	Determination of coefficient of velocity Cc, coefficient of discharge Cd, Flow through large vertical orifice, Derivation for discharge through large orifice-rectangular orifice	To make the student gain knowledge & to know Determination of Cc, Cd, Large orifice, Derivation of discharge through large rectangular orifice	• Text Book	• Explanation with/without PPT (25 Min) • Numerical on rectangular large orifice (20 Min) • Student Creative Response (5 Min)	Numerical on rectangular large orifice
Day - 8	Derivation for discharge through large orifice-circular orifice	To make the student gain knowledge & to know Discharge through large Circular orifice	• Text Book	• Explanation with/without PPT (25 Min) • Numerical on Circular large orifice (20 Min) • Student Creative Response (5	Numerical on Circular large orifice
Day - 8	Definition of Notch, Weir, classification of Notches and weirs, flow over rectangular notch, Sharp crested weir(including velocity of approach)-Derivation of expression for discharge with and without end contraction.,	To make the student gain knowledge & to know Definition of Notch, Classification of Notch, discharge through notch	• Text Book	• Explanation with/without PPT (25 Min) • Derivation of discharge through notch (20 Min) • Student Creative Response (5min)	Classification of notches

Day - 9	**Derivation of discharge through triangular notch**	**To make the student gain knowledge & to know discharge through triangular notch**	• **Text Book**	• **Derivation of discharge through notch (25 Min)** • **Numerical on rectangular notch with end contraction** • **Student Creative Response (5min)**	• **Numerical on rectangular notch with out end contraction**
Day-10	**Derivation of discharge through Trapezoidal notch notch**	**To make the student gain knowledge & to know discharge through Trapezoidal notch notch**	• **Text Book**	• **Explanation with/without PPT (25 Min)** • **Numerical on triangular notch, trapezoidal notch (20 Min)** • **Student Creative Response (5 Min)**	**Nemerical on triangular, trapezoidal notch**
Day-11	**Derivation of discharge through Cippoletti weir, Stepped Notch**	**To make the student gain knowledge & to know discharge through Cippoletti weir, Stepped Notch, Empirical formulae for discharge-Francis formula, Bazins formula, Rehbock's formula**	• **Text Book**	• **Explanation with/without PPT** • **Derivation of discharge through Cippoletti (25 Min)** • **Derivation of discharge through stepped notch (20 Min)** • **Student Creative Response (5 Min)**	**Numericals on Cippoletti weir, Stepped Notch**

Day-12	Ventilllation of weirs, different types of Nappe, Broad crested-Derivation of expression for discharge	To make the student gain knowledge & to know Ventillation of weirs, Types of Nappe, discharge through broad crested weir	● Text Book	● Explanation with/without PPT (25 Min) ● Derivation of discharge through broad crested weir(20 Min) ● Student Creative Response(5 Min)	Numerical on broad crested weir
Day-13	Submerged weir-Derivation of expression for discharge, Submergence ratio Siphon and Siphon spillway, Proportional Weir or Sutro weir	To make the student gain knowledge & to know Submerged weir, Submergence ratio, Siphon, Siphon spillway, Proportional weir	● Text Book	● Explanation with/without PPT (25 Min) ● Derivation of discharge through submerged weir (20 Min) ● Student Creative Response (5 Min)	Numerical on submerged weir

Schedule and Sequence: Day Plan for Lesson-4
Lesson: 4

Session/ Module / Day	Topic	Objectives	Before Class (Videos, E-Books, Case Studies)	In Class (Activities, Quiz, Solving Problems)	Post Class (Assignment, Discussion Forum)
Day - 1	Laminar flow through pipes	To make the student gain knowledge & to know Laminar flow through pipes: Reynolds experiment, Froude's experiment, Laws of fluid friction for laminar, turbulent flow	● Text Book	● Explanation with/without PPT (35 Min) ● Video (10 Min) ● Student Creative Response (5 Min)	Describe Reynold's experiment, Froude's experiment, laws of fluid friction
Day - 2	Derivation of friction losses or Darcy's Weisbach equation	To make the student gain knowledge & to know Derivation of friction losses or Darcy's Weisbach equation	● Text Book	● Explanation with/without PPT (35 Min) ● Numerical on friction losses (10 Min) ● Student Creative Response (5 Min)	Numerical on friction losses
Day - 3	Minor losses: sudden enlargement, sudden contraction, entrance, exit, obstruction in flow	To make the student gain knowledge & to know Minor losses	● Text Book	● Explanation with/without PPT (10Min) ● Derivation of expression for sudden expansion, Sudden contraction(30 Min) ● Numericals on minor losses (10 Min)	Numericals on major and minor losses

	passage, bend, pipe fittings,				
Day - 4	Head loss due to pipes in series – pipes in parallel,	To make the student gain knowledge & to know Head loss due to pipes in series – pipes in parallel,	● Text Book	● Explanation with/without PPT (10 Min) ● Numerical on 2 reservoir problem (35 Min) ● Student Creative Response (5 Min)	Numerical on 3 reservoir problem
Day - 5	Total energy line and hydraulic gradient line, sketching HGL, TEL	To make the student gain knowledge & to know HGL, TEL and sketching of HGL and TEL for different pipe problems	● Text Book	● Explanation with/without PPT (10 Min) ● Numerical on Sketching of HGL, TEL (35 Min) ● Student Creative Response (5 Min)	Numerical on sketching HGL, TEL
Day - 6	Variation of friction factor with Reynold's number – Moody's Chart, Hardy Cross pipe networks distribution	To make the student gain knowledge & to know Moody's Chart Hardy Cross pipe networks distribution	● Text Book	● Explanation with/without PPT (20 Min) ● Numerical on Pipe Networks (35 Min)	Numerical on Pipe Networks

Day - 7	Derivation of Hagen Poisuelle equation, through straight pipe	To make the student gain knowledge & to know Hagen Poiseulle equation through straight pipe	● Text Book	● Explanation with/without PPT (20 Min) ● Numerical on Hagen Poiseulle equation through straight pipe (30 Min)	Numerical on sketching Hagen Poisuelle equation, through straight pipe
Day - 8	Derivation of Hagen Poisuelle equation through inclined pipe	To make the student gain knowledge & to know Hagen Poiseulle equation through inclined pipe	● Text Book	● Explanation with/without PPT (20 Min) ● Numerical on Hagen Poiseulle equation through inclined pipe (30 Min)	Numerical on Hagen Poiseulle equation through inclined pipe
Day - 9	Flow between parallel plates-Both plates at rest	To make the student gain knowledge & to know Flow between parallel plates-Both plates at rest	● Text Book	● Explanation with/without PPT (20 Min) ● Numerical on Flow between parallel plates-Both plates at rest (30 Min)	Numerical on Flow between parallel plates-Both plates at rest
Day - 10	Flow between parallel plates-Both plates at rest & inclined	To make the student gain knowledge & to know Flow between parallel plates-Both plates at rest & inclined	● Text Book	● Explanation with/without PPT (20 Min) ● Numerical on Flow between parallel plates-Both plates at rest and inclined(30 Min)	Numerical on Flow between parallel plates-Both plates at rest and inclined

Day - 11	Flow between parallel plates-Upper plate moving	To make the student gain knowledge & to know Flow between parallel plates-Upper plate moving	● Text Book	● Explanation with/without PPT (20 Min) ● Numerical on Flow between parallel plates-Upper plate moving (30 Min)	Numerical on Flow between parallel plates-Upper plate moving

Session/ Module / Day	Topic	Objectives	Before Class (Videos, E-Books, Case Studies)	In Class (Activities, Quiz, Solving Problems)	Post Class (Assignment, Discussion Forum)
Day - 1	Boundary layer – concepts, Displacement, Energy, Momentum thickness, Prandtl contribution, Characteristics of boundary layer along a thin flat plate,	To make the student gain knowledge & to know Boundary layer – concepts, Displacement, Energy, Momentum thickness, Prandtl contribution, Characteristics of boundary layer along a thin flat plate,	● Text Book	● Explanation with/without PPT (30 Min) ● Video ((20 Min)	Derivation of mathematical expressions for displacement, energy, momentum thickness
Day - 2	Boundary layer equations, Von-Karman Integral Momentum equation	To make the student gain knowledge & to know Boundary layer equations, Von-Karman Integral Momentum equation	● Text Book	● Explanation with/without PPT (25 Min) ● Video (20 Min) ● Student Creative Response (5 Min)	Queries
Day - 3	Boundary layer equations, Von-Karman Integral	To make the student gain knowledge & to know Boundary layer equations, Von-Karma	● Text Book	● Explanation with/without PPT (25 Min) ● Video (20 Min) ● Student Creative Response	Queries

	Momentum equation	n Integral Momentum equation		(5 Min)	
Day - 4	**Derivation of Von-Karman Integral Momentum equation**	**To make the student gain knowledge & to know Derivation of Von-Karman Integral Momentum equation**	● **Text Book**	● **Explanation with/without PPT (40 Min)** ● **Student Creative Response (5 Min)**	**Queries**
Day - 4	**Boundary layer equation for laminar flow**	**To make the student gain knowledge & to know Blasius equation for Nominal thickness, displacement thickness, Momentum thickness. Equations for local drag coefficient, Drag force. Equation for average drag coefficient, Friction drag force**	● **Text Book**	● **Explanation with/without PPT (40 Min)** ● **Numerical in computing Drag force (15 Min)**	**Numerical in computing Friction Drag force**

Day - 5	**Bound ary layer equatio n for Turbul ent flow**	To make the student gain knowledge & to know equation for Nominal thickness, Equations for local drag coefficient, Drag force. Equation for average drag coefficient, Friction drag force for Transition, Turbulent flow, Schlichting, Prandtl equation, Prandtl-Schlichting equation for Average drag coefficient for different ranges of Reynold's number. Equation of laminar sub-layer	● **Text Book**	● **Explanation with/without PPT (40 Min)** ● **Numerical in computing Drag force, laminar sub layer (15 Min)**	**Numerical in computing Friction Drag force, laminar sub layer**
Day - 6	**Hydrodyna mically smooth and rough surfaces, Seperation of boundary layer, methods of controlling**	To make the student gain knowledge & to know Hydrodyna mically smooth and rough surfaces, Seperation of boundary layer, methods of	● **Text Book** ● **Video links/UR L**	● **Explanation with/without PPT (25 Min)** ● **Video (20 Min)** ● **Student Creative Response (5 Min)**	**Queries**

	separation of boundary layer.	controlling separation of boundary layer.			
Day -7	Flow around submerged objects: Drag and Lift- Magnus effect.	To make the student gain knowledge & to know Flow around submerged objects: Drag and Lift- Magnus effect.	● Text Book	● Explanation with/without PPT (25 Min) ● Video (20 Min) ● Student Creative Response (5 Min)	Numericals on computation of Drag and lift force

TEXT BOOK:

1. Hydraulics & Fluid mechanics including fluid machines-Modi & Sethi, Standard Publishers.