DEPARTMENT OF CHEMICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	**MOMENTUM TRANSFER**		
Course Code	**CLPC13**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**NIL**		
Session	**July 2021**	**Section (if, applicable)**	
Name of Faculty	**Dr.M.Perumalsamy**	**Department**	**Chemical Engineering**
Email	**mpsamy@nitt.edu**	**Telephone No.**	**04312503112**
Course Type	√ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Properties of fluids and concept of pressure: Introduction - Nature of fluids - physical properties of fluids - types of fluids. Fluid statics: Pressure - density - height relationships. Pressure Measurement. Units and Dimensions - Dimensional analysis. Similarity - forces arising out of physical similarity - dimensionless numbers.

Momentum Balance and their Applications: Kinematics of fluid flow: Stream line -stream tube - velocity potential. Newtonian and non-Newtonian fluids - Time dependent fluids - Reynolds number - experiment and significance - Momentum balance - Forces acting on stream tubes - Potential flow - Bernoulli's equation - Correction for fluid friction - Correction for pump work.

Flow of Incompressible Fluids Through Ducts: Flow of incompressible fluids in pipes - laminar and turbulent flow through closed conduits - velocity profile & friction factor for smooth and rough pipes - Head loss due to friction in pipes, fitting etc. Introduction to compressible flow. Isentropic flow through convergent and divergent nozzles and sonic velocity.

Flow of Fluids through Solids: Form drag - skin drag - Drag co-efficient. Flow around solids and packed beds. Friction factor for packed beds. Ergun's Equation - Motion of particles through fluids - Motion under gravitational and centrifugal fields - Terminal settling velocity. Fluidisation - Mechanism, types, general properties - applications.

Transportation and Metering: Measurement of fluid flow: Orifice meter, venturi meter, pitot tube, rotameter, weirs and notches Wet gas meter and dry gas meter. Hot wire and hot film anemometers. Transportation of fluids: Fluid moving machinery performance. Selection and specification. Air lift and diaphragm pump. Positive displacement pumps: Rotary and Reciprocating pumps. Centrifugal pumps and characteristics.

COURSE OBJECTIVES
1. To impart the fundamental concepts of fluid statics, pressure distribution and dimensional analysis 2. To nurture the students to solve fluid dynamics problems using Newton's laws of motion. 3. To enable students to compute velocity profile ,friction factor and head loss in pipes and fittings 4. To impart the knowledge of metering and transportation of fluids and fluid moving machinery performance

COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
The students would have	
the Knowledge of fundamental concepts in fluids statics and to use dimensional analysis for scaling experimental results	1, 2, 3, 5, 8, 11, 12
the ability to solve hydrostatic and fluid flow problems using Newton's laws of motion.	1, 2, 3, 5, 8, 9, 11, 12
the ability to analyse frictional flow in pipes and piping networks and to compute the head loss and power requirements for chemical process equipment	1, 2, 3, 5, 6, 8, 11, 12
the ability to select the metering equipment and fluid moving machinery for an appropriate chemical engineering operations	1, 2, 3, 5, 6, 8, 10, 11, 12

COURSE PLAN – PART II
COURSE OVERVIEW
The Momentum Transfer course is offered for chemical engineering students in the third semester to acquire the knowledge of basic fluid dynamics and its applications in chemical engineering. The course content includes nature of fluid behavior and its properties, measurement of pressure and its relationship with elevation and density of the fluid. Static and dynamic behaviour of fluids and forces acting upon are studied through macroscopic and microscopic analysis and to use differential equations to understand pressure and velocity variations. Turbulence behaviour, concept of boundary layer, friction factor, pipe flow, pressure loss in fittings, flow past an immersed body, flow through packed & fluidized beds are also studied in detail. Measurement of fluid flow and Fluid moving machinery performance. Selection and specification will be discussed

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1.	**Week 1**	Introduction to fluid mechanics and Nature of fluids, Physical properties of fluids	**Online Pen & Paper**
2.	**Week 2**	Newtonian and Non- Newtonian fluids, Pressure - density - height relationships, Pressure Measurement	**Online Pen & Paper**
3.	**Week 3**	Units and Dimensions - Dimensional Analysis, Similarity - forces arising out of physical similarity	**Online Pen & Paper**
4.	**Week 4**	Kinematics of fluid flow: Stream line - stream tube - velocity potential. Reynolds experiment and significant	**Online Pen & Paper**
5.	**Week 5**	Momentum balance - Forces acting on stream tubes - Potential flow - Bernoulli’s equation	**Online Pen & Paper**
6.	**Week 6**	Correction for fluid friction - Correction for pump work.	**PPT**
7.	**Week 7**	Flow of incompressible fluids in pipes - laminar and turbulent flow through closed conduits	**PPT**
8.	**Week 8**	velocity profile & friction factor for smooth and rough pipes -	**PPT**
9.	**Week 9**	Head loss due to friction in pipes, fitting etc.	**PPT**
10.	**Week 10**	Introduction to compressible flow. Isentropic flow through convergent and divergent nozzles	**PPT**
11.	**Week 11**	Flow of Fluids through Solids: Form drag - skin drag - Drag co-efficient. - Flow around solids and packed beds.	**PPT**
12.	**Week 12**	Friction factor for packed beds. Ergun's Equation	**PPT**
13.	**Week 13**	Motion of particles through fluids - Motion under gravitational and centrifugal fields-Terminal settling velocity.	**PPT, Tutorial**

14.	**Week 14**	Fluidisation - Mechanism, types, general properties - applications	**PPT**
15.	**Week 15**	Measurement of fluid flow: Orifice meter, venturi meter, pitot tube, rotameter, Hot wire and hot film anemometers.	**PPT, Tutorial**
16.	**Week 16**	Transportation of fluids: Fluid moving machinery performance. Selection and specification.	**PPT**
17.	**Week 17**	Air lift and diaphragm pump. Positive displacement pumps: Rotary and Reciprocating pumps. Centrifugal pumps and characteristics.	**PPT**

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	**Mode of Assessment**	**Week/Date**	**Duration**	**% Weightage**
1	Cycle Test I	On completion of first two Units	1Hr	25%
2	Cycle Test II	On completion of 3rd and 4th units	1 Hr	25%
3	Assignment (2 Nos)	One after I Cycle test and another after II Cycle test		20% (Each 10 %)
CPA	Compensation Assessment*	After II Cycle test	1Hr	25%
4	Semester exam*	After completing the syllabus	3 Hrs	30 %

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

- Assessing students' performance in the assessment methods
- Questionnaire about the effectiveness of the delivery method, topics and the knowledge gained

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)

<u>MODE OF CORRESPONDENCE (email/ phone etc)</u>

Most of the information will be announced in the class room itself.

Any other correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through class representative via Mail/Phone.

Queries (if required) to the course teacher shall be emailed to mpsamy@nitt.edu

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

COMPENSATION ASSESSMENT

1. Attending all the assessments are MANDATORY for every student.
2. If any student is not able to attend any of the assessments (1, 2 only) due to genuine reason, student is permitted to attend the compensation assessment (CPA).
3. At any case, CPA will not be considered as an improvement test.

ACADEMIC DISHONESTY & PLAGIARISM

- Talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

  The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

The teachers can be contacted in person for clarifications by the student on a mutually convenient

FOR APPROVAL

Course Faculty ____________ **CC-Chairperson** ___________________ **HOD** ______________

Guidelines:

a) The number of assessments for a course shall range from 4 to 6.

b) Every course shall have a final assessment on the entire syllabus with 30% weightage.

c) **One compensation assessment for absentees in assessments (other than final assessment) is mandatory. This is not applicable for project work/industrial lectures/internship**.

d) The policy for attendance for the course should be clearly specified.

e) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.