NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF MATHEMATICS

COURSE PLAN – PART I			
Name of the programme and specialization	**M. Sc. (Mathematics)**		
Course Title	**Fluid Dynamics**		
Course Code	**MA729**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)			
Session	**July 2021**	**Section (if, applicable)**	
Name of Faculty	**Dr. P. Saikrishnan**	**Department**	**Mathematics**
Official Email	**psai@nitt.edu**	**Telephone No.**	**9787877471**
Name of Course Coordinator(s) (if, applicable)			
Official E-mail		**Telephone No.**	
Course Type (please tick appropriately)	☐ **Core course**	☑ **Elective course**	

Syllabus (approved in BoS)

Real Fluids and Ideal Fluids - Streamlines and Path lines; Steady and Unsteady Flows - The Velocity potential – The Vorticity vector - The Equation of continuity - Acceleration of a Fluid – Conditions at a rigid boundary - General analysis of fluid motion - -Euler's equations of motion - Bernoulli's Equation.

Discussion of a case of steady motion under conservative body forces – Some potential theorems- Some Flows Involving Axial Symmetry - Some special two- Dimensional Flows - Impulsive Motion. Some three-dimensional Flows: Introduction - Sources, Sinks and Doublets - Images in a Rigid Infinite Plane - Axi-Symmetric Flows; Stokes stream function

Two-Dimensional Flows: The stream function – The Complex Potential for Two- Dimensional, Irrotational, Incompressible Flow - complex velocity potentials for Standard Two-Dimensional Flows - The Milne-Thomson circle theorem and applications – The Theorem of Blasius

Viscous flow: Stress components in a Real fluid - relations between Cartesian components of stress - Translational Motion of Fluid Element - The Rate of Strain Quadric and Principal Stresses – Some Further properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion - Relations Between stress and rate of strain - The Navier - Stokes equations of Motion of a Viscous Fluid .

Some exact solutions of Viscous Flow - Steady Viscous Flow in Tubes of Uniform cross section - Diffusion of Vorticity - Energy Dissipation due to Viscosity - Steady Flow past a Fixed Sphere - Dimensional Analysis; Reynolds Number - Prandtl's Boundary Layer.

Reference Books:

1. F. Chorlton, Text book of fluid dynamics, CBS Publishers & Distributors, 2005
2. J.D. Anderson, Computational Fluid Dynamics, The Basics with Applications, McGraw Hill, 2012.
3. G.K. Batchelor, An Introduction to Fluid dynamics, Cambridge University Press,2000.
4. Richard E. Meyer, Introduction to Mathematical Fluid Dynamics, Courier corporation, 2012
5. A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer Science & Business media, 2013

COURSE OBJECTIVES

Objective of the course, is to

1. understand physics involve in fluid flow problems and apply laws of conservation to construct mathematical model.
2. find mathematical solution of some viscous and inviscid flow problems

MAPPING OF COs with POs

Course Outcomes: Completion of the course, student will be able to	**Programme Outcomes (PO)** (Enter Numbers only)
1. understand physical concept involved in fluid motion.	**A,b,d**
2. model some two and three dimensional flows of viscous and inviscid fluid flows	**A,b,d**
3. find mathematical solution of some fluid flow problems and interpret results physically	**A,b,d**

COURSE PLAN – PART II

COURSE OVERVIEW

This course will introduce

1. **the basic concepts in fluid dynamics and**
2. **mathematical model and methods to solve fluid mechanics problems.**

COURSE TEACHING AND LEARNING ACTIVITIES **(** Add more rows)

S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	1st -2th week	Real Fluids and Ideal Fluids - Streamlines and Path lines; Steady and Unsteady Flows - The Velocity potential – The Vorticity vector - The Equation of continuity - Acceleration of a Fluid – Conditions at a rigid boundary - General analysis of fluid motion - -Euler's equations of motion - Bernoulli's Equation.	Online-Through MS Teams

2	3rd -5th week	Discussion of a case of steady motion under conservative body forces – Some potential theorems- Some Flows Involving Axial Symmetry - Some special two- Dimensional Flows - Impulsive Motion. Some three-dimensional Flows: Introduction - Sources, Sinks and Doublets - Images in a Rigid Infinite Plane - Axi-Symmetric Flows; Stokes stream function	Online-Through MS Teams
3	6th -9th week	Two-Dimensional Flows: The stream function – The Complex Potential for Two- Dimensional, Irrotational, Incompressible Flow - complex velocity potentials for Standard Two-Dimensional Flows - The Milne-Thomson circle theorem and applications – The Theorem of Blasius	Online-Through MS Teams
4	10th-11th week	Viscous flow: Stress components in a Real fluid - relations between Cartesian components of stress - Translational Motion of Fluid Element - The Rate of Strain Quadric and Principal Stresses – Some Further properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion - Relations Between stress and rate of strain - The Navier - Stokes equations of Motion of a Viscous Fluid .	Online-Through MS Teams
5	12th – 14th week	Some exact solutions of Viscous Flow - Steady Viscous Flow in Tubes of Uniform cross section - Diffusion of Vorticity - Energy Dissipation due to Viscosity - Steady Flow past a Fixed Sphere - Dimensional Analysis; Reynolds Number - Prandtl's Boundary Layer.	Online-Through MS Teams

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment -1 (online exam)	6th week	1 hour 30mins	25
2	Assessment – 2 (online exam)	12th week	1 hour 30 mins	25

3	Assessment – 3 (Assignments)			20
4	Assessment-4 (semester Exam, online exam)	15th week	2 hours	30
CPA	Compensation Assessment*	13th week	1 hour 30mins	25

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

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

1. Students can meet the faculty at any stage in the course duration in case he/she finds difficulty in understanding the concept.
2. Feedback form issued to students to express their comments about the course before assessment - 1 & after completing the syllabus. Students are requested to give genuine feedback about the course.
3. Student knowledge about the topic covered in this course will be judged through marks obtained in examination.

COURSE POLICY (including compensation assessment to be specified**)**

1. Examination:
   a) Students who have missed the assessment – 1 or assessment - 2 or both can register the Compensation Assessment which shall be conducted soon after the completion of the assessment – 2 and before the regular semester examination (assessment – 4).
   b) The Compensation Assessment shall be conducted for 25 marks comprising the syllabus of both assessment – 1 and assessment - 2.
   c) Students were strictly not allowed to enroll for Compensation Assessment to improve their marks.
   d) Students should submit assignments before last date of submission. In case students fails to submit their assignments, he/she will get zero mark for that particular assignment.

2. The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades. All assessment of a course will be done on the basis of marks.

3. Supplementary Examination
   a) Students who get "F" or "X" grade and satisfactory attendance in the courses are eligible for Supplementary Examination.

   b) The Supplementary Examination will normally be held during a specific week of the subsequent semesters. The supplementary examination shall be scheduled by the Office of the Dean Academic

   c) The Supplementary Examination will be conducted by the course teacher who offered the course or a faculty member nominated by the HoD/Mathematics.

   d) The weightage for the supplementary examination shall be 100%. Absolute grading system with a passing minimum of 40% shall be followed.

In case a student fails in the Supplementary Examination he/she has to reappear till the student passes the course.

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.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, 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, IF ANY

Students can reach course faculty by fixing appointment through E-mail (psai@nitt.edu) or phone (9787877471 or intercom: 3687).

FOR APPROVAL

Dr. P. Saikrishnan
Course Faculty

CC- Chairperson _____ **HOD** _____

Guidelines

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

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

c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.

d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

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