

**CHE211A: Fluid Mechanics and its Applications**  
**2019-20 II Semester**

**Administrative Details**

**Instructor:** Dr. Indranil Saha Dalal,  
Department of Chemical Engineering  
Office location: FB-467  
Contact: phone 6702, email: indrasd@iitk.ac.in

**(1) Textbooks:**

*Introduction to Fluid Mechanics*, by R. W. Fox, Alan T. McDonald and Philip J. Pritchard (Wiley, 8<sup>th</sup> edition)

*Fluid Mechanics*, by F. M. White (McGraw Hill 8<sup>th</sup> edition)

*Unit Operations of Chemical Engineering*, by W. L. McCabe, J. C. Smith and P. Harriott (McGraw Hill 7<sup>th</sup> Edition)

**(2) Class times:** MWF 10 – 11 am, L3

**(3) Marks distribution:**

Quiz (total 4): Each carries 10% (total 40%)

Mid Sem Exam: 25%

End-Semester Exam: 35%

- Quizzes will be held on 3rd Feb, 7th Feb, 14th Feb and 8th April, as per the regular lecture schedule. These dates will not be changed. If needed, there can be extra makeup quizzes in class (dates of these will not be announced).

**(4) Ethics:** Cheating in any quiz/exam will lead to an F grade.

**(5) Attendance** will be recorded in every lecture.

**(6)** For students missing the quizzes, the marks will be prorated only for one quiz. The concerned student(s) must submit a medical certificate from the health center within a week of the absence from the quiz for administrative clearance.

**(7)** For students missing the mid-semester examination, marks will be prorated provided that the student possesses a medical certificate from the health center and if he submits the necessary application with signatures from appropriate authorities.

**(8)** For students missing the End-semester examinations, the makeup examination is administered through DOAA office and the concerned student(s) should be aware of the rules.

## Course Outline

- **Introduction:** Fluid, fluid types, continuum hypothesis, viscosity, velocity and stress fields.
- **Fluid Statics:** Pressure distribution, hydrostatic forces on submerged plane surfaces
- **Kinematics:** flow visualization - streamlines, pathlines, streakline, timelines.
- **Integral/Macroscopic balances:** Control volume, Conservation of mass, energy and linear momentum. Application of macroscopic balances.
- **Differential balances:** Differential equations of mass conservation, differential equations of linear momentum, Navier-Stokes equations. Application of differential balances.
- **Dimensional analysis and similarity:** Buckingham Pi theorem, dimensionless numbers.
- **Pipe/Duct flows:** Laminar vs turbulent flows, head loss, friction factor, Moody chart, hydraulic diameter, losses.
- **Flow meters:** Pitot tube, venture, orifice, rotameter.
- **Flow past immersed bodies:** Creeping flow, Inviscid flow Bernoulli equation, boundary layer, drag on flat plate for laminar flow, drag on immersed bodies.
- **Flow through packed and fluidized beds:** Kozeny-Carman equation, Ergun equation, Fluidization, particle settling.
- **Mechanical operations:** Filtration, Centrifuges and cyclones, Mixing and agitation.
- **Flow machinery:** Pumps, efficiency, cavitation.
- **Other topics:** multiphase flow, introduction to CFD, Turbulence, Microfluidics.