Course code	Course Name	L-T-P-Credits	Year of Introduction
CH206	FLUID AND PARTICLE MECHANICS-II	3-0-0-3	2016

Prerequisite : CH205 Fluid and particle mechanics -I

Course Objectives

To impart the knowledge of fluid mechanics and its applications in chemical engineering.

Syllabus

Flow Past Immersed Bodies, Fluidization, Pumps, Fans, Blowers, Compressors, Fundamentals of Compressible Fluids, Agitation and Mixing

Expected Outcome

At the end of the course the students will be able to:

1. Outline the fluid flow around immersed solids and calculate the pressure drop in fluidized beds and packed beds.
2. Examine the fluidization behaviour and write model equations for fluidized beds which are required for the design of gas-solid fluidized bed reactors.
3. Calculate the flow rates of compressible flows in fluid moving machinery.
4. Determine the effects of variable cross-sectional area on sub- and supersonic flows.
5. Select mixing equipment used in process industries

References Books:

- McCabe W.L. & Smith J.C., Unit Operations of Chemical Engg, McGraw Hill
- Streeter V.L., Fluid Mechanics, McGraw Hill
- Coulson J.M. & Richardson J.F., Chemical Engg. Vol. 1, Pergamon
- Foust, Wenzel, Clump, Maus& Anderson, Principles of Unit Operation
- 5.Noel de Nerves, Fluid Mechanics for Chemical Engineers, McGraw Hill.
- Kunii and Levenspiel, "Fluidization Engineering"

Module	Contents	Hours	Sem. Exam Marks
I	Flow past immersed bodies - Drag coefficient - Flow through packed bed - Ergun equation -Kozney-Carman equation - Blake Plummer equation - Design of packed beds - Motion of particles through fluids - Motion from gravitational and centrifugal fields - Terminal settling velocity - Approximate equation - Stoke's law - Intermediate law - Newton's law – Hindered settling	7	15%
II	Fluidization - The phenomenon of fluidization - Liquid-like behaviour of fluidized beds - Comparison with other contacting methods - Advantages and disadvantages of fluidized beds for industrial applications - fluidization quality. Pressure drop - vacuum - flow rate diagrams, minimum fluidizing velocity, effect of pressure and temperature on fluidized bed behaviour. The expanded bed - Flow patterns in fluidized beds - Design of fluidized beds.	7	15%

FIRST INTERNAL EXAMINATION			
III	General description, classification and application of Centrifugal, Reciprocating, Gear and Lobe Pumps. Various losses, Characteristic curves, NPSH, Cavitation, Specific speed, Priming of Centrifugal pumps. Fans and Blowers- classification, power consumption. Compressors – classification, Positive displacement compressors, reciprocating compressors, multistaging, power consumption, compressor output.	7	15%
IV	Compressible fluids - Mach number - Continuity equation - Total energy balance – Mechanical energy balance - Ideal gas equation - Equations for isentropic flow - Adiabatic frictional flow Isothermal flow - Measurement of compressible fluid flow.	7	15%
SECOND INTERNAL EXAMINATION			
V	Non-Newtonian fluids - Time dependent flow - Viscosity, rate of shear Vs. shear stress for non- Newtonian fluids - Agitation and mixing of liquids - Agitation equipments - Impellers, propellers, paddles, turbines, flow patterns in agitated vessels, standard turbine design, circulation, velocities and power consumption in agitated vessels - Flow number – velocity gradient and velocity patterns, power correlations, dimensionless groups, blending and mixing, mixer selection, scale-up of agitator design.	7	20%
VI	Mixing of solids and pastes - Mixers for pastes and plastic masses - change can mixers, kneaders, dispersers and masticators, mixer extruders, mixing rolls, Muller mixers, power requirements, mixing index, mixers for dry powders, mix index in blending granular solids.	7	20%
END SEMESTER EXAMINATION			

Evaluation Scheme

- **Internal Evaluation: Total Marks: 50**
  (i) *Total Marks for Assignment/Seminar/Project/Case study or any other appropriate tool used for the evaluation of the course outcomes:* **10**
  A minimum of above two tools shall be used. If more than 2 tools are used, proportionate change shall be made in the marks so that the total contribution of marks for item (i) above remains at 10.
  (ii) Marks for Tests: Two tests each carrying 40% weightage shall be conducted with total contribution of **40 marks**.

- **External Evaluation :** University Examination
  Maximum Marks : 100
  Exam Duration : 3 Hours

Question Paper Pattern:

There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.

(2 x15= 30 Marks)

There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.

(2 x15= 30 Marks)

There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.

(2 x20= 40 Marks)