5th Semester	RBT5D006	Bioreactors Design and Analysis	L-T-P 3-0-0	3 Credits

Module I: **(8 Hours)**

Recapitulation of the principles of Kinetics for chemical and Bio-chemical Reactions. Fundamentals of homogeneous reactions for batch / semi-batch, plug low reactor (PFR), continuous stirred rank reactors (CSTR), fluidized bed reactor bubble column, air lift fermenter etc, stirred tank/mixed reactors., adiabatic and programmed reactors.

Module II: **(10 Hours)**

Unconventional bioreactors: Hollow fiber reactor, membrance reactor, perfusion reactor for animal and plant cell culture. Analysis of ideal bioreactors: Fed-Batch reactors, Enzyme catalyzed reactions in CSTRs, CSTR reactors with Recycle and wall growth, Ideal Plug-Flow Tubular reactor. Analysis of Nonideal Reactor Analysis:

Module III: **(8 Hours)**

Concept of ideal and non-ideal reactor; residence time distribution; models of non-ideal reactors – plug flow reactor for microbial processes; Mass transfer in biochemical processes; Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells; three – phase fluidized bed trickling bed reactor; Design and analysis of the above reactor systems; Gas liquid reactors, Reactor stability.

Module IV: **(8 Hours)**

Design considerations: oxygen transfer, heat transfer, rheology, mixing. Scale up and scale down concepts. Bioprocess control and computer coupled bioreactors; Growth and product formation by recombinant cells. Mechanical fittings in a bioreactor: vessel, agitation system materials, welds, finish, valves, piping and valves for biotechnology.

Module V: **(8 Hours)**

Instrumentation and control of bioprocesses: Bioreactor sensor, online sensors for cell properties, off-line analytical methods; Biosensors. Bioreactor design calculation.

(6 Hours)

Books:

[1]   Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.

Digital Learning Resources:

Course Name:	Bioreactors
Course Link:	https://nptel.ac.in/courses/102/106/102106053/
Course Instructor:	Prof. G.K. Suraishkumar