Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCHD501	Membrane Technology	3	0	0	3

Course Objective
To provide an in-depth knowledge i) in membrane separation processes and ii) on the selection of a membrane process for different applications and iii) operational issues, limitations and system configuration, and design..
Learning Outcomes
Students will be able to i) characterize membrane and calculate membrane flux, permeability etc. ii) solve problems for any application in chemical processes, biotechnology, environmental pollution control etc., and iii) clean and wash membranes for their reutilization.

Unit No.	Description of Lectures	Lecture Hrs.	Learning Outcomes
1.	**Overview of membrane science and technology:** Types of Membranes, Membrane Processes-microfiltration, ultrafiltration, nanofiltration, and reverse osmosis.	5	Students will learn the basic of membrane technology.
2.	**Membrane transport theory:** Solution-diffusion model, pore-flow membranes.	5	Students will learn various transport theories.
3.	**Membranes and modules:** Isotropic membranes, anisotropic membranes, inorganic membranes, liquid membranes and hollow fiber membranes.	9	Students will get basic idea about various membrane modules.
4.	**Concentration polarization and fouling:** Concentration polarization in liquid separation processes, gel layer model, osmotic pressure model, boundary layer resistance model, concentration polarization in gas separation processes, membrane fouling and fouling control.	10	Students will learn different fouling mechanisms.
5.	**Applications of membrane processes and economics:** Gas separation, pervaporation, ion exchange membrane processes, membrane contactors, membrane distillation, membrane reactors and membrane bioreactors, medical applications of membranes, membranes for water treatment and desalination	10	Students will learn about the applications of membrane technology.
6.	**Economic analysis:** Economic analysis of membrane processes	3	Students will get some idea about the economic analysis of membrane processes.
	Total	**42**	

Textbooks:

1. Baker, R. W. (2012), *Membrane Technology and Applications*, 3rd Ed., Wiley, UK.
2. Mulder, M. Mulder, J. (1996) "*Basic Principles of Membrane Technology*", Kluwer Academic.

Reference Books:

1. W. S. W. Ho and K. K. Sirkar (1992), *Membrane Handbook*, Chapman & Hall, NY.
2. N.N. Li, A. G. Fane, W.S.W. Ho and T. Matsuura, (2008), *Advanced Membrane Technology*, Wiley.
3. M. Cheryan, (1998), *Ultrafiltration and Microfiltration Handbook*, CRC Press.