UNIVERSITÀ DEGLI STUDI DI PALERMO

SCHOOL	POLYTECHNIC SCHOOL
ACADEMIC YEAR	2016/2017
FIRST CYCLE COURSE	BIOMEDICAL ENGINEERING
SUBJECT	MEMBRANE TECHNOLOGIES FOR BIOMEDICAL ENGINEERING
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50297-Ingegneria chimica
CODE	18416
SCIENTIFIC SECTOR(S)	ING-IND/26
HEAD PROFESSOR(S)	CIPOLLINA ANDREA Ricercatore a tempo determinato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
YEAR	3
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**CIPOLLINA ANDREA** Monday 13:00 14:00 Studio personale Tuesday 13:00 14:00 Studio personale Wednesday 13:00 14:00 Studio personale Thursday 13:00 14:00 Studio personale

DOCENTE: Prof. ANDREA CIPOLLINA

TEACHING METHODS	Frontal lectures 4 CFU (28 ore) Tutorials 2 CFU (24 ore)
ASSESSMENT METHODS	Final oral examination: The student will be asked at least three questions, on topics included in the program. The aim will be to evaluate whether the student has a good knowledge and comprehension of membrane separation processes, their operating principles and possible applications in the field of biomedical engineering. The minimum threshold to pass the examination will be reached when the student shows a basic knowledge covering at least 70% of the questions asked from the course program, also showing the ability to apply, at least in theory, such knowledge to facing problems in realistic scenarios. The student will also have to properly discuss and present the topic. Below this threshold the student will not pass the exam. Showing better preparation, presentation capabilities and demonstrating a more in depth knowledge of the subjects will result in more and more positive evaluation outcomes.
LEARNING OUTCOMES	Knowledge and comprehension capacity • Knowledge of membrane technologies for biomedical applications and fundamentals of analysis tools applied to membrane processes and devices. Ability to apply the acquired knowledge • Ability to elaborate and develop simplified process schemes and preliminary design of membrane separation devices for biomedical applications Ability to evaluate scenarios • The student will be able to analyse and identify among several technological options the best one to face and solve any specific problem under examination. Communication skills The student will be able to present and discuss topics related to the course program, acquiring communications skills and proper language competences relevant to the field of membrane technologies for biomedical applications. Learning ability • The student will acquire the basic tools for proper analysis and in depth study of any specific aspect related to membrane devices for biomedical applications
EDUCATIONAL OBJECTIVES	To develop fundamental skills on the selection, analysis and design of membrane devices for biomedical applications.
PREREQUISITES	Good knowledge of the fundamentals of fluid dynamics and transport phenomena, basic knowledge of materials science and technology
SUGGESTED BIBLIOGRAPHY	Mulder: “Basic Principles of Membrane Technology”, 2nd edition, Kluwer Academic Publishers Baker: “Membrane Technology and Applications”, 3rd edition, Wiley

SYLLABUS

Hrs	Frontal teaching
10	FUNDAMENTALS OF MEMBRANE SEPARATION PROCESSES Introduction to membrane processes – definition of a membrane – materials and properties – membrane classification and characterisation – transport phenomena – membrane modules geometries and configurations
6	PRESSURE DRIVEN MEMBRANE PROCESSES Reverse Osmosis: Fundamentals and applications – Microfiltration – Ultrafiltration - Nanofiltration – polarisation phenomena – fouling and bio-fouling – Hemofiltration devices – air membrane purification devices – gas membrane separation for nitrogen and oxygen production for medical applications
3	GAS-LIQUID MEMBRANE CONTACTORS Thermally-Driven membrane separation: Membrane Distillation and Pervaporation – Temperature polarisation phenomena – Membrane devices for blood oxygenation
4	ELECTROMEMBRANE PROCESSES Fundamentals and applications of electromembrane processes – Ion Exchange Membranes: materials and characterisation–Dialysis process the treatment of saline solutions – haemodialysis units
5	PERSPECTIVES FOR APPLICATION OF MEMBRANE TECHNOLOGY IN BIOMEDICAL ENGINEERING “controlled drug delivery” systems – membranes application in control systems for bio-medical applications; “disposable membrane cartridges” in medical applications

Hrs	Practice
24	Analysis and design tools for membrane-based devices for Bio-Medical applications