UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche
ACADEMIC YEAR	2016/2017
MASTER'S DEGREE (MSC)	BIOETCHNOLOGIES FOR INDUSTRY AND SCIENTIFIC RESEARCH
SUBJECT	PRINCIPLES OF BIOCHEMICAL EQUIPMENT
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50594-Discipline chimiche
CODE	08299
SCIENTIFIC SECTOR(S)	ING-IND/24
HEAD PROFESSOR(S)	BRUCATO VALERIO Professore Ordinario Univ. di PALERMO MARIA BARTOLO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**BRUCATO VALERIO** **MARIA BARTOLO** Tuesday 14:00 15:00 Studio del docente, Viale delle Scienze, Edificio 6, Stanza 3019, Palermo Wednesday 14:00 15:00 Studio del docente, Viale delle Scienze, Edificio 6, Stanza 3019, Palermo Thursday 14:00 15:00 Studio del docente, Viale delle Scienze, Edificio 6, Stanza 3019, Palermo

DOCENTE: Prof. VALERIO MARIA BARTOLO BRUCATO

PREREQUISITES	Basic knowledge on: algebra, functions, infinitesimal calculus, mechanics, thermodinamics, phase equilibria.
LEARNING OUTCOMES	Knowledge and understanding - After the course the student will become conscious of problems related to transport phenomena and simple fluid dynamic relationships. He will be able to do simple hydrostatic calculations, transfer coefficients evaluation and apply mass, energy and momentum balance equations to process units; - he will know the main biochemical reactors type and the related project and management issues. Skills in application knowledge and understanding - The student will be able to select and use the needed and appropriate relationships for the project of biochemical plant units as well as of biochemical reactors. Making judgements - The student will be able to autonomous evaluate: relationships applicability, results reliability and confidence, boundary conditions to apply to transport phenomena problems; the matching of a biochemical recator type to specific process requirements. Communication skills - The student will acquire the skill of state and transfer problems related to course topics. he will be able to discuss problems involving transport phenomena and biochemical reactors by the use of the appropriate scheme mathematics and terminology. Learning skills - By the acquired knowledge on transport phenomena the student will own the fundamental approach of balance equations to complex problems; - furthermore he will know the difference between qualitative and quantitative approach to units and biochemical reactors problems so he will be able to face the successive Biochemical Plants Design course.
ASSESSMENT METHODS	The assessment will be based on class test + oral. The following score table will be applied: Indicator - Knowledge and competence of contents Descriptor and score range: Excellent 10 Autonomous and effective 8-9 Acceptable 6-7 Fragmentary or partly superficial 4-5 Inadequate 0-3 Indicator - Applicative skill, precision, logical-thematiccoherence Descriptor and score range: Excellent 10 Adequate 8-9 Acceptable also if partly driven 6-7 Limited 4-5 Inadequate 0-3 Indicator - Expression and terminology, reprocessing skills and multi-disciplinary connections Descriptor and score range: Excellent 10 Effective and well-structured 8-9 Generally satisfactory 6-7 Hesitant and rough 4-5 Inadequate 0-3
EDUCATIONAL OBJECTIVES	The course aim to train the students towards professional expertise on applied research on biotechnology. Necessary fundamentals to face problems related to the use of biochemical plant units and bioreactors will be provided. This basic knowledge is necessary to well face the successive Biochemical Plant Design

	course and is directly applicable to the development of expertise on biochemical reactors. fundamentals and application of transport phenomena knowledge for professional work as well as applied research.
TEACHING METHODS	Lectures, practical class.
SUGGESTED BIBLIOGRAPHY	Bird R.B., Stewart W.E., Lightfoot E.N., Fenomeni di trasporto, Casa Editrice Ambrosiana, Milano (1970) R. Mauri – Fenomeni di Trasporto – PLUS Pisa University Press – ISBN: 9788884928290 Lezioni

SYLLABUS

Hrs	Frontal teaching
2	Course introduction. Algebra and infinitesimal calculus fundamentals. Unit of measure and dimensions; dimensional consistency; unit conversion; molecular weight definition.
3	Steady state mass balance: examples. Continuum mechanics elements, stress definition; fluid definition; fluid density. Hydrostatic; pressure definition; static constant density fluid pressure distribution.
2	Molar fraction, weight fraction; volumetric concentration. Balance principle. Mass balance. Transient mass balance example.
3	Hydrostatic stress; fluid dynamics; Newton law of viscosity; viscosimeter. Non Newtonian fluids; pipe and channel flow; Reynolds experience; flow regime; pipe friction factor.
3	Heat transfer; conduction convection and radiant heat transfer, units. Conduction heat transfer; Conduction in flat and cylindrical geometry.
2	Stress due motion around submerged objects; terminal velocity.
3	Series heat transfer resistance combination, forced convection. Conduction and convection in cylindrical objets.
3	Mass transfer, Fick's law. Mass transfer coefficient, Chilton-Colburn analogy, series combination of mass transfer resistances.
2	Energy balance. Open systems energy balance. Temperature distribution along a heated or cooled pipe.
3	Biochemical reactor classification; ideal reactors: batch reactor, mixed tank reactor, plug flow reactor; generation rate of component; ideal reactor design. Chemical reaction kinetics effects on ideal reactor design; autocatalytic reactions reactor volume. Biochemical reactor modeling; reaction rate kinetics modeling; Michaelis Menten kinetic.
3	Cellular mass kinetics; Monod equation. CSTR fermenter design; immobilized cell chemostat; cell recycle chemostat.
3	Cell batch bioreactor design; fed batch reactor modeling and design.

Hrs	Practice
16	Practical class for calculation on the course topics.