UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
MASTER'S DEGREE (MSC)	BIOMATERIALS ENGINEERING
SUBJECT	TRANSPORT PHENOMENA FOR BIOMEDICAL APPLICATIONS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20973-Attività formative affini o integrative
CODE	19624
SCIENTIFIC SECTOR(S)	ING-IND/34
HEAD PROFESSOR(S)	BRUCATO VALERIO Professore Ordinario Univ. di PALERMO MARIA BARTOLO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° 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	Consolidated knowledge on: algebra, functions of one or more variable, infinitesimal calculus, mechanics, chemistry, phase equilibrium and state diagrams.
LEARNING OUTCOMES	knowledge and understanding - After the course the student will become conscious of problems related to transport phenomena and will have understood: mass, energy and momentum balance equations as well as related transport constitutive models. Basic knowledge of radiant heat transfer, friction factors and heat and mass transfer coefficients will be provided. - The student will be able to select and use the needed and appropriate relationships for material for biomedical application processing. making judgements - The student will be able to autonomous evaluate transport phenomena relationships applicability, results reliability and confidence, boundary conditions to apply to transport phenomena problems. learning skills - learning of new and more complex approach to problems involving the course topics will be easier as fundamentals and logic approach scheme to face problems are current contents of the course. communication skills - The student will acquire the skill of state and tranfer problems related to course topics by the use of the appropriate scheme mathematics and terminology.
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 on fundamentals and application of transport phenomena knowledge for professional work as well as applied research on material for biomedical application processing and forming.
TEACHING METHODS	Lectures, practical class.
SUGGESTED BIBLIOGRAPHY	Bird R.B., Stewart W.E., Lightfoot E.N., Fenomeni di trasporto, Casa Editrice Ambrosiana, Milano (1970), ISBN: 978-8808080622 R. Mauri – Fenomeni di trasporto. – Pisa University Press; 3 edizione (9 luglio 2014), ISBN: 978-8867413522

SYLLABUS

Hrs	Frontal teaching
16	Course introduction. Stress and stress tensor. Newtonian fluid rheology. General balance principle, mass, momentum and energy macroscopic balance. Simple laminar local momentum balance and solution, Stokes law. Laminar vs turbulent flow, Reynolds number, turbulent flow features. Dimensional analysis and Buckingham theorem, friction factor. Non Newtonian fluid rheology, power law, shear thinning, Carreau Model and viscoelasticity. Viscosity measurements, falling sphere, capillary, Couette, cone-plate and plate-plate, frequency measurements and Cox-Merz Rule.

SYLLABUS

Hrs	Frontal teaching
10	Heat flow, Fourier's law, conductivity dependence on temperature, Prandtl number. Energy balance, simple conduction local balance and solution. Heat exchange coefficient and heat conduction trough composite walls, heat conduction with heat generation. Heat conduction in transient conditions, Biot number. Dimensional analysis and heat exchange coefficients correlations. Radiant heat transfer between black and grey bodies.
10	Mass transfer, Fick's law, diffusivity dependence on temperature and pressure and Schmidt number. Boundary conditions for mass transfer. Diffusion in presence of surface chemical reactions. Transient mass transfer in solids. Mass transfer coefficients, dimensional analysis and analogy in transport phenomena. Mass transfer across the series combination of different phases.

Hrs	Practice
10	Calculation of tangential stress in capillary flow, around spheres and submerged bodies. Calculation of torque couette, plate-cone, plate-plate flow. Viscosimetric data reperesentation and analysis.
4	Calculation of conduction heat flow with and without generation in several geometries. Evaluation of heat exchange coefficients. Lumped and distributed transient heat flow calculations.
4	Calculation of mass flow in stationary diffusion in several geometries. Evaluation of mass transfer coefficients. Lumped and distributed transient mass flow.