



# UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2017/2018
MASTER'S DEGREE (MSC)	MATERIALS SCIENCE AND ENGINEERING
SUBJECT	TRANSPORT PHENOMENA FOR MATERIALS ENGINEERING
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20973-Attività formative affini o integrative
CODE	18578
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)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	<b>BRUCATO VALERIO</b> <b>MARIA BARTOLO</b> 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

<b>PREREQUISITES</b>	Consolidated knowledge on: algebra, functions of one or more variable, infinitesimal calculus, mechanics, chemistry, phase equilibrium and state diagrams.																														
<b>LEARNING OUTCOMES</b>	<p>knowledge and understanding</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- The student will be able to select and use the needed and appropriate relationships for material processing.</li> </ul> <p>making judgements</p> <ul style="list-style-type: none"> <li>- The student will be able to autonomously evaluate transport phenomena relationships applicability, results reliability and confidence, boundary conditions to apply to transport phenomena problems.</li> </ul> <p>learning skills</p> <ul style="list-style-type: none"> <li>- 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.</li> </ul> <p>communication skills</p> <ul style="list-style-type: none"> <li>- The student will acquire the skill of state and transfer problems related to course topics by the use of the appropriate scheme mathematics and terminology.</li> </ul>																														
<b>ASSESSMENT METHODS</b>	<p>The assessment will be based on class test + oral. The following score table will be applied:</p> <p>Indicator - Knowledge and competence of contents Descriptor and score range:</p> <table> <tr><td>Excellent</td><td>10</td></tr> <tr><td>Autonomous and effective</td><td>8-9</td></tr> <tr><td>Acceptable</td><td>6-7</td></tr> <tr><td>Fragmentary or partly superficial</td><td>4-5</td></tr> <tr><td>Inadequate</td><td>0-3</td></tr> </table> <p>Indicator - Applicative skill, precision, logical-thematic coherence Descriptor and score range:</p> <table> <tr><td>Excellent</td><td>10</td></tr> <tr><td>Adequate</td><td>8-9</td></tr> <tr><td>Acceptable also if partly driven</td><td>6-7</td></tr> <tr><td>Limited</td><td>4-5</td></tr> <tr><td>Inadequate</td><td>0-3</td></tr> </table> <p>Indicator - Expression and terminology, reprocessing skills and multi-disciplinary connections Descriptor and score range:</p> <table> <tr><td>Excellent</td><td>10</td></tr> <tr><td>Effective and well-structured</td><td>8-9</td></tr> <tr><td>Generally satisfactory</td><td>6-7</td></tr> <tr><td>Hesitant and rough</td><td>4-5</td></tr> <tr><td>Inadequate</td><td>0-3</td></tr> </table>	Excellent	10	Autonomous and effective	8-9	Acceptable	6-7	Fragmentary or partly superficial	4-5	Inadequate	0-3	Excellent	10	Adequate	8-9	Acceptable also if partly driven	6-7	Limited	4-5	Inadequate	0-3	Excellent	10	Effective and well-structured	8-9	Generally satisfactory	6-7	Hesitant and rough	4-5	Inadequate	0-3
Excellent	10																														
Autonomous and effective	8-9																														
Acceptable	6-7																														
Fragmentary or partly superficial	4-5																														
Inadequate	0-3																														
Excellent	10																														
Adequate	8-9																														
Acceptable also if partly driven	6-7																														
Limited	4-5																														
Inadequate	0-3																														
Excellent	10																														
Effective and well-structured	8-9																														
Generally satisfactory	6-7																														
Hesitant and rough	4-5																														
Inadequate	0-3																														
<b>EDUCATIONAL OBJECTIVES</b>	The course aims to train the students on fundamentals and application of transport phenomena knowledge for professional work as well as applied research on material processing and forming.																														
<b>TEACHING METHODS</b>	Lectures, practical class.																														
<b>SUGGESTED BIBLIOGRAPHY</b>	<p>Bird R.B., Stewart W.E., Lightfoot E.N., Fenomeni di trasporto, Casa Editrice Ambrosiana, Milano (1970), ISBN: 978-8808080622</p> <p>R. Mauri – Fenomeni di trasporto. – Pisa University Press; 3 edizione (9 luglio 2014), ISBN: 978-8867413522</p>																														

## 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 through 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 representation 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.