MATERIALS ENGINEERING AND NANOTECHNOLOGY (LM56)

(Lecce - Università degli Studi)

Teaching TRANSPORT PHENOMENA

GenCod A003095

Owner professor Carola ESPOSITO CORCIONE

Teaching in italian TRANSPORT PHENOMENA

Teaching TRANSPORT PHENOMENA

SSD code ING-IND/24

Reference course MATERIALS ENGINEERING AND

Course type Laurea Magistrale

Credits 9.0

Teaching hours Front activity hours: 81.0

For enrolled in 2018/2019

Taught in 2018/2019

Course year 1

Language ENGLISH

Curriculum PERCORSO COMUNE

Location Lecce

Semester Second Semester

Exam type Oral

Assessment Final grade

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course is focused on the study of the transport phenomena occurring in fluid/solid materials: mass, heat and momentum transfer. These phenomena greatly regulate and control all the processes (transformation, production, manufacture, etc.) involving materials in their whole life cycle. The course will illustrate the use of: balances (of mass, energy and momentum), both in microscopic and macroscopic scales and in laminar and turbulent flow; transport coefficients (friction, heat and mass) between different phases; empirical correlations for turbulent flow. Several case studies will be presented in the course, in order to illustrate the practical use of the mathematical equations introduced in the lessons.

COURSE AIMS

Knowledge and understanding

The course is focused on the study of the These phenomena greatly regulate and control all the processes (transformation, production, manufacture, etc.) involving materials in their whole life cycle. The course will illustrate the use of: balances (of mass, energy and momentum), both in microscopic and macroscopic scales and in laminar and turbulent flow; transport coefficients (friction, heat and mass) between different phases; empirical correlations for turbulent flow. Several case studies will be presented in the course, in order to illustrate the practical use of the mathematical equations introduced in the lessons.

Applying knowledge and understanding:

The course provides abilities in transport phenomena problem solving applied in materials engineering field.

Making judgements:

The course gives the ability to integrate knowledge and handle complexity, and to solve transport phenomena problems occurring in fluid/solid materials: mass, heat and momentum transfer.

Communication

Students have to be able to communicate their conclusions and rationale to specialist
, by using a technical language based on formulas and theorems, and non-specialist audiences by using a narrative language based on elementary concepts.

Learning skills

Students are trained to develop creative thinking, critical spirit, and autonomy , by using as a knowledge technique examples and counter-examples. The theoretical approach of the course is a good tool to improve their ability of abstraction

TEACHING METHODOLOGY

Theoretical and practice lessons

ASSESSMENT TYPE

written exam

FULL SYLLABUS

Theoretical lessons :

- Moment Transfer

Constitutive Equation : Newton law. Non newtonian fluids flow. Moment balance. Distribution of velocity in the laminar flow and in the solids.

- Heat Transfer

Constitutive equation : Fourier law of conduction. Distribution of temperature in the laminar flow. Heat balance.

- Mass transfer

Constitutive equation : Fick's law of diffusion. Distribution of concentration in the laminar flow and in the solids.

- Conservation equations for isothermal systems with one ore more components.

- Non steady state

Conservation equations for non steady state. Dimensionless number : Biot.

- Moment Transfer in laminar and turbolent flow.

Dimensional analysis of the conservation equations. Dimensionless groups : definitions and physical meant. Case study : flow past immersed sphere.
Distribution of velocity in turbulent flow. Mediated expressions for the moment conservation equations.

- Heat Transfer in laminar and turbolent flow.

Case studies : heat conduction in a cooling wing, natural heat convection.
Dimensional analysis of the conservation equations. Dimensionless groups : definitions and physical meant.
Distribution of temperature in turbulent flow. Mediated expressions for the heat conservation equations.

- Dimensional analysis technique.

- Transport coefficient for isothermal systems.

Coefficient for moment transfer : friction factor. Transport in pipes and past immersed objects. Correlations between dimensionless groups of the moment transport.

- Transport coefficient for non isothermal systems.

Heat transfer coefficient. Transport in pipes and past immersed objects. Dimensionless groups for natural and forced heat convection. Correlations between dimensionless groups of the heat transport.

- Transport coefficient for multi- components systems.

Mass transfer coefficient. Transport in pipes and past immersed objects. Dimensionless groups for natural and forced mass convection. Correlations between dimensionless groups of the mass transport.

- Macroscopic balances
  - Macroscopic balances for isothermal and non isothermal systems with one ore more components. Mass macroscopic and moment balance. Macroscopic balance of energy and mechanic energy (Bernoulli equation).

Practice:

- Transport problems in steady and non steady state.

Solution of balance and transport equations for problems in steady and isothermal state with one or more components.

- Solution of the conservation equations for the non steady state.

- Solution of the transport problems for isothermal and non isothermal systems with one or more components.

- Solution of steady and non steady state problems, using macroscopic balance for Macroscopic balances

REFERENCE TEXT BOOKS

- R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport phenomena, Casa Editrice Ambrosiana.
- L. Theodore, transport phenomena for engineers, International Textbook Company, U.S.
- A. S. Foust, L. A. Wenzel, C. W. Clump, L. Maus, L.B. Andersen, I principi delle operazioni unitarie, Editrice Ambrosiona, Milano.