COURSE DESCRIPTION
DIAGNOSTIC DEVICES AND DRUG DELIVERY

SSD: BIOINGEGNERIA INDUSTRIALE (ING-IND/34)

DEGREE PROGRAMME: BIOINGEGNERIA INDUSTRIALE (P16)
ACADEMIC YEAR 2024/2025

COURSE DESCRIPTION

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
TEACHING LANGUAGE: INGLESE
CHANNEL: FG A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 9

REQUIRED PRELIMINARY COURSES

n.a.

PREREQUISITES

Biomaterials, Thermodynamics, Fluidodynamics and Transport Phenomena

LEARNING GOALS

The course aims to provide the basic elements for the understanding and processing of biological and physio-pathological systems, with particular reference to compartmental models of pharmacokinetics and pharmacodynamics. An introductory part has objectives to analyze pharmacokinetic tools, biological barriers and their relationship with the structures of the human body and their functioning. In the second part of the course, students will learn the design principles of devices for the transposition of drugs, both therapeutic and diagnostic. The industrial production and preclinical and clinical validation of devices will also be addressed.

The lessons will alternate with seminars with experts from the industrial and academic world, exercises and laboratory activities where the student can practice what they have learned, using applications for simulation and identification of the models considered but also laboratory material. The goal is to provide students with conceptual and operational tools that allow them to develop the entire process of designing and manufacturing devices used to transport drugs.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

i) Understanding of the main concepts of pharmacokinetic modeling and design of devices for the delivery and transport of drugs
ii) Knowledge of the technological and scientific rationale underlying the design, production and validation of drugs and their transport devices, whether diagnostics or therapeutics
iii) Understanding and analyzing the biological barriers involved in the transport and efficacy of drugs

Applying knowledge and understanding

i) Interpret the Physico-chemical and biological information deriving from the interactions of devices and drugs with the human body
ii) Apply the knowledge learned for the design, production and validation of devices for the transport and release of active and non-active substances
iii) Interpretation of clinical data and extrapolation of useful and relevant information for the design
iv) Critical analysis of own and others' data and the development of medical technologies
v) Communication in English of the knowledge learned and the result of their application using appropriate terminology, both oral and written.

COURSE CONTENT/SYLLABUS

Introduction to the concept of delivery in therapy and diagnosis

Fundamentals of Drug Delivery: drug transport, reaction, and disappearance in physiological and pathological situations
Fundamentals of Diffusion in Drug Delivery, Diagnosis and Therapy from single molecules to complex environment
Notes about Regulatory Procedures

Pharmacokinetics and Pharmacodynamics in the Design of Controlled Delivery Systems

ADME Definition and model
PK parameters and Models
Peroral and non-peroral Barriers to Drug Delivery and Diagnosis

Drug Delivery Systems: engineering design, testing and production methods.

Prodrugs as Drug Delivery Systems
Diffusion-Controlled Drug Delivery Systems
Dissolution Controlled Drug Delivery Systems
Osmotic Controlled Drug Delivery Systems

Device Controlled Delivery of Powders

Delivering nanomedicine to Solid Tumor
Biodegradable Polymeric Delivery Systems
Carrier- and Vector-Mediated Delivery Systems for Biological Macromolecules
Targeting Approaches to Drug Delivery
Programmable Drug Delivery Systems
Introduction to diagnostic devices
POC testing concept
Strip-based POC assays: capillary flow-tests, Dipsticks, Lateral flow tests, Advances in capillary flow-tests
Nanomaterial-based POC assay
Nanoparticles Gold nanoparticles(GNPs)
Magnetic nanoparticles(MNPs)
Carbon nanomaterial-based POC –Graphene
Biosensing and Homecare devices
Novel Nanoarrays in Diagnostics
Miniaturized diagnostic devices
Lab-on-chip

READINGS/BIBLIOGRAPHY

1. Drug Delivery: Engineering Principles for Drug Therapy, W. Mark Saltzman, Oxford University Press, 2001
2. Drug Delivery: Fundamentals and Applications, Anya M. Hillery and Kinam Park, 2nd Edition, CRC Press, 2016
3. Transport Phenomena in Tumors, R. Jain, Advances in Chemical Engineering, Published by Elsevier 1994

TEACHING METHODS OF THE COURSE (OR MODULE)

Lectures, laboratory activities, seminars, individual meetings in the classroom or even online outside class hours

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☑ Project discussion
- ☑ Other : The exam will be held entirely in English. There will be a short report of the laboratory activities and the discussion of a case study assigned to the individual student after the first part of the course.

In case of a written exam, questions refer to

- ☐ Multiple choice answers

☐ Open answers

☑ Numerical exercises

b) Evaluation pattern