

CURSO: Mestrado e Doutorado em Ciências da Saúde	Turno: Integral
Ano: 2026	Semestre: 2
Docente Responsável: Renê Oliveira do Couto	

INFORMAÇÕES BÁSICAS			
Currículo	Unidade curricular Topical and Transdermal Drug Delivery Systems		Departamento CCO
Período -	Carga Horária (horas)		
	Teórica	Prática	Total
	30	15	45
Tipo Optativa	Habilitação / Modalidade Mestrado e Doutorado		Pré-requisito -
			Co-requisito -

EMENTA
This course provides an integrated understanding of the principles, development, characterization, and evaluation of topical and transdermal drug delivery systems (TTDDS). Students will explore skin anatomy and physiology in relation to drug transport, formulation strategies, regulatory aspects, <i>in vitro</i> and <i>in vivo</i> evaluation methods, and kinetic modeling. The course combines theoretical and experimental approaches, emphasizing translational research and product development. The course will be delivered entirely in English. This course will give to graduate students an unique opportunity to acquire competences in terms of knowledge and skills in the topical and transdermal delivery field, what is in the market and how does research extend knowledge and understanding. Proposed teaching methodology will take advantage of teaching staff expertise and motivation to create opportunities favoring close interaction between teacher(s) and students, and between students with different backgrounds. This interaction should inspire students attending the course to prepare a research project proposing a potential solution for a topical or transdermal problem using an advanced drug delivery approach or a skin permeation methodology-based approach. At the end of the course the graduate students must be able to demonstrate an integrated knowledge concerning the multidisciplinary of Topical and Transdermal Delivery and be able

to propose a new therapeutic strategy or measuring approach demonstrating the capacity to integrate acquired concepts into novel outcomes with scientific and social impact.

OBJETIVOS

- General
 - ✓ To provide advanced knowledge and practical skills for the rational design, characterization, and evaluation of topical and transdermal drug delivery systems.
- Specific Objectives
 - ✓ Understand the structure and function of the skin as a barrier and a drug delivery route.
 - ✓ Analyze the main types of topical and transdermal dosage forms and their technological challenges.
 - ✓ Apply regulatory and ethical principles to the development of topical/transdermal formulations.
 - ✓ Design and perform in vitro release and permeation studies.
 - ✓ Perform kinetic modeling of drug release and skin permeation data.
 - ✓ Critically interpret experimental results and scientific literature on dermal drug delivery.
 - ✓ Correlate the content with the pharmaceutical care practice

CONTEÚDO PROGRAMÁTICO

The course will be offered from August 12 to November 18, 2026, on Wednesdays.

Theoretical activities: 2:00–4:00 PM (place to be defined)

Practical activities: 2:00–5:00 PM (at LADEF or Central Analítica)

I. Theoretical Component (30 h)

Module	Content	Hours
1. Introduction to Dermal Drug Delivery	- Concepts of topical vs. transdermal delivery - Historical evolution and therapeutic relevance - Advantages and limitations of the dermal route	2 h
2. Anatomy, Histology, and Physiology of the Skin	- Structure and function of the skin - Stratum corneum barrier and appendageal routes - Factors influencing dermal absorption (physicochemical, biological, and formulation-related)	2 h
3. Formulation Strategies for Topical and Transdermal Systems	- Semisolids (creams, gels, emulgel, ointments) - Patches, films, and microneedle-based systems - Penetration enhancers and nanocarriers - Introduction to pharmaceutical rheology	2 h
4. Evaluation Methods and Kinetic Modeling	- <i>In vitro</i> release, permeation, and retention tests - Franz-type diffusion cells - Mathematical models (zero-order, Higuchi, Korsmeyer-Peppas, Gompertz, Weibull, etc.)	2 h

5. Regulation and Safety Aspects	- ANVISA, EMA, and FDA guidelines - Good Laboratory and Manufacturing Practices (GLP/GMP)	2 h
6. Literature Seminar and Scientific Discussion	- Ethical issues in preclinical and clinical evaluation - Student seminar presentations (chosen topics from recent papers or case studies) - Critical discussion of scientific evidence	2 h
7. Formative Evaluation	- Formal written test covering theoretical content	2 h
8. Research Project Presentation and Discussion	- Pitch presentation and written research project proposing a potential solution to a topical or transdermal therapeutic challenge using an advanced drug delivery system or a skin permeation-based approach	2 h
9. Extra Class Activities	- For the research project development	14 h
II. Practical Component (15 h)		
Activity	Description	Hours
1. Preparation of Model Formulation	Development of topical systems (gel or film) containing a model drug (e.g., caffeine, quercetin, or diclofenac).	3 h
2. In Vitro Drug Release Test	Use of Franz diffusion cells or dialysis membrane setup to obtain release profiles.	3 h
3. In Vitro Skin Permeation and Tape Stripping Technique	Use of excised skin or synthetic membranes to assess drug permeation and skin retention.	3 h
4. Data Analysis and Kinetic Modeling	Calculation of kinetic parameters using models (Higuchi, Korsmeyer-Peppas, Gompertz, Weibull, Probit, Makoid-Banakar).	3 h
5. Discussion and Reporting	Interpretation of experimental data and preparation of a concise scientific report.	3 h
METODOLOGIA DE ENSINO		
Course content will be delivered through interactive lectures, team-based practical laboratory activities, individual and group assessments, collective discussions of technical cases and scientific articles, as well as group dynamics. Depending on the selected topics, guest speakers may be invited to deliver synchronous webinars addressing specific themes according to their areas of expertise. Instructional resources will include multimedia presentations, videos, collaborative production assignments, and virtual learning environments (the UFSJ Didactic Portal and the TeamMates platform). An adapted Team-Based Learning (TBL) approach will be employed. Study guidance aligned with the learning objectives will be provided prior to each class through the sharing of core and		

supplementary instructional materials. Students will be organized into multidisciplinary teams based on the completion of an online assessment form (Kolb's Learning Diagnostics). Each team will work throughout the semester on a research project aligned with the course topics, involving the development of methodologies and strategies to address an innovative research question in transdermal or topical drug delivery with scientific and social impact.

This project should propose a potential solution for a topical or transdermal problem using an advanced drug delivery approach or a skin permeation methodology-based approach. The project is expected to adhere to the following general structure: a) Title; b) Conceptual hurdle and innovative idea to be tested (Introduction and Justificative); c) Plan and methods (Material, methods, and chronogram); d) Relevance (scientific and social impact); and e) References. Project evaluation will be made according to the following criteria: novelty and relevance (30%); clear description of the proposed approach (40%); interdisciplinarity of the research plan (30%).

Extra-class activities will be dedicated to the development of the research project, including literature review, formulation design, experimental planning, data analysis, preparation of technical reports, and pitch presentation development.

CRITÉRIOS DE AVALIAÇÃO

Component	Description	Weight
Seminar presentation	Critical analysis and oral presentation of a recent research article related to TTDDS (n = 1)	20%
Written theoretical test	Evaluation of understanding of theoretical concepts and regulatory aspects (n = 1)	20%
Research Project Presentation and discussion		30%
Laboratory report	Data presentation, interpretation, and kinetic modeling (n = 1)	20%
Participation and engagement	Attendance ($\geq 75\%$ in both theoretical and practical activities), discussion, and performance during practical classes	10%

BIBLIOGRAFIA BÁSICA

- 1) CHIEN Y; Novel Drug Delivery Systems, Second Edition, (Drugs and the Pharmaceutical Sciences) 2nd Edition
- 2) AULTON ME.; TAYLOR KMG; Aulton – Delineamento de Formas Farmacêuticas - Edição: 4; 2016; Elsevier

- 3) ALLEN JR. LV; POPOVICH NG; ANSEL HC. Formas Farmacêuticas e Sistemas de Liberação de Fármacos. 9.ed. Porto Alegre: Artmed, 2013. 716 p.
- 4) ANSEL HC; STOKLOSA M. Cálculos Farmacêuticos. 12.ed. Porto Alegre: Artmed, 2008. 451p.
- 5) FLORENCE AT; ATTWOOD D. Princípios Físico-químicos em Farmácia. 2.ed. São Paulo: Pharmabooks, 2011. 690 p.
- 6) GENNARO A.R. Remington: A Ciência e a Prática da Farmácia. 20.ed. Rio de Janeiro: Guanabara Koogan, 2004. 2208 p.
- 7) PRISTA LN et al. Tecnologia Farmacêutica. 8.ed. Lisboa: Fundação Calouste Gulbenkian, 2011. v.1. 786 p.
- 8) ROWE R. et al. Handbook of Pharmaceutical Excipients. 7.ed. London: Pharmaceutical Press, 2012. 1033 p.
- 9) STORPIRTIS S; GAI MN; CHIANN C; GONÇALVES JE. Biofarmacotécnica. Rio de Janeiro: Guanabara Koogan. 2009.

BIBLIOGRAFIA COMPLEMENTAR

- 1) LOPEZ RFV; GRATIERI T; GELFUSO GM. Physical Methods to Increase Topical and Transdermal Drug Delivery. Transworld Research Network, 2012. ISBN: 978-81-7895-555-1.
- 2) FLORENCE AT; ATTWOOD D Physicochemical Principles of Pharmacy In Manufacture, Formulation and Clinical Use 6^a ed SP, Royal Pharmaceutical Society, 2016.
- 3) KULKARNI VS. Handbook of Non-Invasive Drug Delivery Systems, 1st Edition, Science and Technology, 2010, Authors: Elsevier (e-book)
- 4) MATHIOWITZ E; CHICKERING III DE; LEHR CM. Bioadhesive Drug Delivery Systems: Fundamentals, Novel Approaches, and Development, July 13, 1999 by CRC Press
- 5) RANADE VV; CANNON JB. Drug Delivery Systems, Third Edition, April 25, 2011 by CRC Press
- 6) HADGRAFT J. Transdermal Drug Delivery Systems: Revised and Expanded (Drugs and the Pharmaceutical Sciences) 2nd Edition, 2002, Kindle Edition
- 7) DONNELLY RF; SINGH TRR. Novel Delivery Systems for Transdermal and Intradermal Drug Delivery, 2015
- 8) SINKO PJ. Martin: Físico-farmácia e ciências farmacêuticas. 5.ed. Porto Alegre:

Artmed, 2008. 809p.

9) NETO BB, SCARMINIO IS, BRUNS RE. Como Fazer Experimentos: Pesquisa e Desenvolvimento na Ciência e na Indústria. Bookman; 4ª edição (26 março 2010). 414p

10) BAREL AO; PAYE M; MAIBACH HI. Handbook of Cosmetic Science and Technology, CRC Press, 4TH Ed. 2014

11) EMA/FDA/Anvisa guidelines on topical/transdermal products and bioequivalence studies.

LEITURA COMPLEMENTAR

Recent review articles on nanocarriers, film-forming systems, and microneedles for transdermal delivery.

OECD Guidelines for In Vitro Skin Absorption Studies.

ICH Q8, Q9, and Q10 guidelines on pharmaceutical development and quality risk management.