



German Jordanian University

School of Applied Medical Sciences

Department of Pharmaceutical- Chemical Engineering

Master of Pharmaceutical Engineering – Thesis Track

Study Plan 2026

Introduction

Pharmaceutical and Chemical Engineering (PCE) at the German Jordanian University (GJU) addresses the interface between engineering sciences, pharmaceutical manufacturing, regulatory compliance, and industrial operations. The discipline supports the design, control, and optimization of pharmaceutical production systems while ensuring alignment with global quality and regulatory expectations.

The PCE MSc degree is structured around two primary tracks: a Thesis Track and a Non-Thesis Track. Within each track, students select one of two specialization pathways.

The Pharmaceutical and Chemical Engineering track emphasizes quantitative analysis, engineering fundamentals, and process-oriented problem solving, with focus on transport phenomena, thermodynamics, modeling, and scale-up considerations relevant to pharmaceutical and chemical systems.

The Pharmaceutical Operations & Logistics track addresses operational, regulatory, and supply chain dimensions of pharmaceutical systems, emphasizing strategic, economic, and logistics-driven decision environments. This structure enables alignment between academic progression and professional orientation while preserving program coherence.

Through the Thesis Track, students will:

- Acquire advanced research competencies and methodological skills required for rigorous investigation in pharmaceutical and chemical engineering contexts.
- Work closely with faculty supervisors to formulate, design, and execute research addressing scientifically and industrially relevant engineering problems.
- Develop the ability to critically analyze technical literature, apply appropriate experimental, analytical, or modeling approaches, and interpret results with technical precision.
- Strengthen scientific reasoning, problem formulation, and evidence-based argumentation consistent with graduate-level engineering research.
- Demonstrate mastery of written and oral communication through the preparation, presentation, and defense of a research thesis.

This track is intended for students pursuing research-oriented careers, advanced technical roles, or doctoral studies (Ph.D.), as well as those seeking deeper analytical and investigative expertise in pharmaceutical and chemical engineering domains. With its emphasis on scientific rigor, independent inquiry, and systematic problem solving, the Thesis Track complements the Non-Thesis Track by providing a pathway focused on research, knowledge generation, and advanced technical specialization.

I. Program Objectives

- a. Use pharmaceutical engineering techniques for the development, purification, and scale-up of biological and advanced therapeutic products.
- b. Develop expertise in pharmaceutical product design and process engineering, with a focus on drug delivery systems, formulation science, and industrial scalability.
- c. Apply pharmaceutical and process engineering principles to support the development, production, and quality assurance of biologics and complex pharmaceuticals.
- d. Promote sustainable and green manufacturing practices, integrating environmentally responsible technologies and energy/resource efficiency across production systems.
- e. Implement comprehensive quality assurance and regulatory strategies, aligned with GxP, FDA, EMA, and ICH standards, including validation and digital compliance.
- f. Analyze pharmaceutical market dynamics and global supply chains, assessing costing, market access and regulatory pathways.
- g. Build leadership, project management, and entrepreneurial capabilities, enabling students to manage cross-functional teams, drive innovation, and lead pharmaceutical ventures.

II. Learning Outcomes

Upon completion of this program, students will be able to:

- a. Evaluate pharmaceutical manufacturing systems by identifying process constraints, variability sources, and performance limitations, and technically justified improvement strategies with engineering reasoning.
- b. Analyze pharmaceutical process and product behavior using governing engineering and physicochemical principles to interpret manufacturability, robustness, and operational feasibility.
- c. Evaluate quality and validation strategies within regulated pharmaceutical environments using risk-based reasoning, controlled-state concepts, and compliance-driven decision logic.
- d. Evaluate pharmaceutical operational and supply chain systems using structured analytical frameworks, performance metrics, and constraint-aware decision approaches.
- e. Formulate and defend engineering and operational solutions to pharmaceutical system problems under technical, regulatory, and organizational constraints using structured problem-solving methodologies.
- f. Integrate and analyze technical, quality, and operational information to support evidence-based reasoning and system-level decision-making in pharmaceutical engineering contexts.

Track-Specific Outcomes:

- **Pharmaceutical & Chemical Engineering Track:** Apply quantitative engineering and scientific principles to analyze, model, and optimize pharmaceutical processes and manufacturing systems.
- **Pharmaceutical Operations & Logistics Track:** Apply systems, regulatory, and operational principles to design, manage, and optimize pharmaceutical supply chains, distribution networks, and logistics-driven decision environments.

Both specializations share a common pharmaceutical engineering core and differ only in applied system focus; all graduates satisfy Pharmaceutical Engineering program outcomes.

Course Delivery Methods

Courses are in one of the following three methods:

- **Face-to-Face (F2F) Method**
Courses using this method are delivered by faculty in person in regularly scheduled class sessions physically on campus.
- **Blended (BLD) Method**
Courses are delivered in a hybrid mode of physical face-to-face class sessions and asynchronous material including online instructional videos, presentations, projects, and similar learning activities.
- **Online (OL) Method**
Courses are delivered exclusively online. A hybrid of synchronous regularly scheduled class sessions delivered via the Internet, and asynchronous material including online instructional videos, presentations, projects, and similar learning activities. No physical face-to-face meetings are required.

III. Admission Requirements

- **Academic Requirement:** the applicant must hold an undergraduate degree in relevant STEM / engineering disciplines from a recognized university with a minimum average of “Good”.
- **English Language Requirement:** the language of instruction at BS is English. As such, one of the admission requirements is proficiency in English; a minimum TOEFL score of 79 out of 120 on an Internet-based test (iBT), a minimum International English Language Testing System (IELTS) score of 5.5.
- All admitted students are initially registered in the Non-Thesis Track. Transfer to the Thesis Track after completion of the first academic year, to the Thesis Track is permitted only after completion of the first academic year and is subject to cumulative GPA requirements and departmental capacity constraints.
- Students must complete the required credit hours for their chosen track (Thesis or Non-Thesis) within a maximum of two years.

IV. Degree Requirements (Credit hours)

Classification	Credit Hours
Compulsory Courses and Master Thesis	21
Track-Specific Compulsory Courses	6
Elective Courses	6
Total	33

V. Curriculum (33 Credit hours)

1. Compulsory Requirements: (21 credit hours)

Course ID	Course Name	Credit Hours	ECT S	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE7501	Pharmaceutical Process Design	3		3	0	F2F	N/A
PCE7502	Quality Assurance & Validation	3		3	0	F2F	N/A
MBA727	Business Research Method	3		3	0	F2F	N/A
PCE7504	Pharmaceutical Instrumental Analysis	3		3	0	F2F	N/A
PCE7991	Master Thesis	3		0	3	BLD	N/A
PCE7992	Master Thesis	3		0	3	BLD	N/A
PCE7993	Master Thesis	3		0	3	BLD	N/A
Total		21		12	9		

1. (A) Compulsory Requirements / Pharmaceutical Operations & Logistics Track (6 Credit Hours out of the following):

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE7611	Pharmaceutical Business Strategy & Market Dynamics	3		3	0	F2F	N/A
PCE7612	Innovation, Intellectual Property & Regulatory Strategy	3		3	0	F2F	N/A
LOGS721	Logistics and Supply Chain Management	3		3	0	F2F	N/A
Minimum Required		6		6	0		

1. (B) Compulsory Requirements / Pharmaceutical & Chemical Engineering Track (6 Credit Hours out of the following):

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE7721	Thermodynamics & Phase Behavior in Pharmaceutical Systems	3		3	0	F2F	N/A
PCE7722	Process Modeling, Optimization & Scale-Up	3		3	0	F2F	N/A
PCE7723	Transport Phenomena in Chemical and Pharmaceutical Processes	3		3	0	F2F	N/A
Minimum Required		6		6	0		

2. Elective Courses: (6 Credit hours out of the following)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
MBA7903	Organizational Behaviour & Leadership	3		3	0	F2F	N/A
MBA7409	Strategic Management	3		3	0	F2F	N/A
LOGS711	Applied Data Analysis	3		3	0	F2F	N/A
LOGS712	Production & Operations Management	3		3	0	F2F	N/A
MBA7608	Entrepreneurship and Innovation	3		3	0	F2F	N/A
MBA7304	Accounting for Decision Making	3		3	0	F2F	N/A
MBA7405	Human Resources Management	3		3	0	F2F	N/A
MBA7900	Marketing Management	3		3	0	F2F	N/A
LOGS732	Supply Network Design and Optimization	3		3	0	F2F	N/A
LOGS724	Warehousing & Inventory Management	3		3	0	F2F	N/A
MBA7905	Total Quality Management	3		3	0	F2F	N/A
Minimum Required		6		6	0		

VI. Study Plan Guide

First Year (Common Courses)							
First Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE7501	Pharmaceutical Process Design	3		3	0	F2F	N/A
PCE7502	Quality Assurance & Validation	3		3	0	F2F	N/A
Total		6	0	6	0		

First Year (Common Courses)							
Second Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
MBA727	Business Research Method	3		3	0	F2F	N/A
PCE7504	Pharmaceutical Instrumental Analysis	3		3	0	F2F	N/A
	Elective Course	3		3	0	BLD	N/A
Total		9	0	9	0		

Second Year (Pharmaceutical Operations & Logistics Track)							
First Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE761x Or LOGS721	Pharmaceutical Operations & Logistics Compulsory Course Or Logistics and Supply Chain Management	3		3	0	F2F	N/A
PCE761x	Pharmaceutical Operations & Logistics Compulsory Course	3		3	0	F2F	N/A
PCE7991	Master Thesis	3		0	3	BLD	N/A
Total		9	0	6	3		

Second Year (Pharmaceutical Operations & Logistics Track)							
Second Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE7992	Master Thesis	3		0	3	BLD	N/A
PCE7993	Master Thesis	3		0	3	BLD	N/A
	Elective Course	3		3	0	BLD	N/A
Total		9		3	6		

Second Year (Pharmaceutical & Chemical Engineering Track)							
First Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE772x	Pharmaceutical & Chem Engineering Compulsory Course	3		3	0	F2F	N/A
PCE772x	Pharmaceutical & Chem Engineering Compulsory Course	3		3	0	F2F	N/A
PCE7991	Master Thesis	3		0	3	BLD	N/A
Total		9		6	3		

Second Year (Pharmaceutical & Chemical Engineering Track)							
Second Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect	Lab		
PCE7992	Master Thesis	3		0	3	BLD	N/A
PCE7993	Master Thesis	3		0	3	BLD	N/A
	Elective Course	3		3	0	BLD	N/A
Total		9		3	6		

VII. Course Descriptions

1. Compulsory Courses

PCE7501 – Pharmaceutical Process Design

Develops systematic approaches for the design and structuring of pharmaceutical processes and production systems. Addresses integration of unit operations, process constraints, scalability, and manufacturability considerations. Emphasizes robustness, process reliability, and quality-linked design logic. Considers interactions between process configuration, product attributes, and operational feasibility. Incorporates regulatory and compliance implications of process design decisions.

PCE7502 – Quality Assurance & Validation

Examines the regulatory, scientific, and operational foundations of pharmaceutical quality systems within GxP-regulated environments. Covers GMP principles, validation lifecycle concepts, qualification strategies, deviation management, CAPA systems, and documentation structures. Emphasizes risk-based validation logic, critical quality attributes (CQAs), and data integrity considerations. Analyzes inspection readiness and compliance-driven decision processes. Focuses on establishing and maintaining controlled, reproducible, and auditable manufacturing systems.

MBA727 – Business Research Method

The primary purpose of this course is to prepare students to critically read business research. The course is introductory in the sense that the emphasis is on exposure to a variety of business research methods, rather than the development of expertise in any one particular method. More specifically, Business Research Methods introduces students to types of scientific and quantitative methods and its applications to the business research process. Additionally, it is designed to acquaint students with the range of research methods available and the criteria for choosing among them.

PCE7504 – Pharmaceutical Instrumental Analysis

Provides an overview of instrumental techniques used for pharmaceutical analysis and characterization. Covers spectroscopic, chromatographic, and related analytical methodologies. Emphasizes interpretation of analytical outputs and their relevance to product quality and control. Addresses applications in regulated and industrial contexts. Focuses on practical analytical reasoning rather than device-level theory.

PCE7611 – Pharmaceutical Business Strategy & Market Dynamics

Examines strategic and economic frameworks shaping pharmaceutical markets and commercialization pathways. Covers competitive positioning, pricing logic, reimbursement systems, and access strategies. Considers regulatory and policy influences on business decisions. Emphasizes analytical reasoning and systems perspectives. Links market dynamics with operational implications.

PCE7612 – Innovation, Intellectual Property & Regulatory Strategy

Explores mechanisms governing pharmaceutical innovation, intellectual property, and regulatory pathways. Covers technology development, patent logic, exclusivity structures, and lifecycle strategies. Examines interactions between innovation and regulatory systems. Emphasizes decision-making and strategic planning implications. Focuses on applied strategic analysis rather than legal doctrine.

LOGS721 – Logistics and Supply Chain Management

Introduces principles governing logistics and supply chain systems within industrial and pharmaceutical contexts. Covers distribution networks, inventory strategies, demand planning, and operational coordination. Emphasizes efficiency, and system optimization considerations. Addresses constraints specific to regulated industries.

PCE7723 – Transport Phenomena in Chemical and Pharmaceutical Processes

Develops advanced understanding of momentum, heat, and mass transport mechanisms. Applies transport principles to pharmaceutical and chemical process systems. Emphasizes quantitative reasoning, modeling, and analytical problem solving. Examines transport-driven performance limitations. Forms a core foundation for process engineering analysis.

PCE7722 – Process Modeling, Optimization & Scale-Up

Introduces modeling approaches and optimization logic for analyzing process systems. Covers conceptual and quantitative tools for system evaluation and improvement. Addresses scale-up challenges and operational constraints. Emphasizes structured engineering reasoning and performance analysis. Links theoretical methods with industrial applications.

PCE7721 – Thermodynamics & Phase Behavior in Pharmaceutical Systems

Examines thermodynamic principles governing phase equilibria and material behavior. Covers solution behavior, multiphase systems, and energy interactions. Emphasizes predictive reasoning and engineering implications. Addresses relevance to pharmaceutical processes and formulations. Supports process design and system evaluation frameworks.

2. Elective Courses

MBA7903 – Organizational Behaviour & Leadership

This course is about people in organizations, focusing on how management and leadership practices affect the attitudes, motivation, behaviors, and performance of employees and teams. Course content is derived mostly from contemporary theory, research, and practice in the organizational behavior and management disciplines. Students will be encouraged to use course material to be self-aware and mindful about how they lead and interact with others, and to adopt an ethic of continuous self-improvement in their leadership, teamwork, and interpersonal skills. This course is experiential and interactive. Real case examples will be presented often along with guest speakers and students are encouraged to read the news and stay abreast of changes in the business environment which directly apply to classroom topics.

LOGS711 – Applied Data Analysis

This course covers quantitative models and statistical methods for decision-making and data analysis. It considers the topics of: hypothesis testing, regression and correlation analysis, forecasting techniques, linear programming, decision analysis, and project management.

LOGS712 – Production & Operations Management

This course is designed to introduce the students to the concepts, principles and practices in the field of operations management and its relationships with other functions in an organization. In addition, this course attempts to provide techniques required for the effective management of operations in both service and manufacturing organizations. Students will have substantial benefit from understanding the role of operations management in organizations.

MBA7409 – Strategic Management

The course brings together what the MSc. students have learned in the business disciplines into strategy to achieve a sustainable competitive advantage through discussions of strategy formulation, selection and implementation. It relies heavily on interactive and case analysis learning methods. This course teaches MSc. students the science and art of business and corporate level strategies in modern organisations to achieve long

term strategic objectives in today's turbulent business environment. It teaches MSc. students the process of strategic management and business policy as a usual business practice that is embedded in the organisation's culture, especially on the top levels of management. Resources-based theory, dynamic strategic capabilities, governance and business politics are an essential part of this course

MBA7608 – Entrepreneurship and Innovation

Due to the harsh competition, technological advancement, globalization, and dramatic change in the business environment, innovation and entrepreneurship have become the vital source for enhancing organizational effectiveness and wealth in market economies. Thus, this course examines relevant theories and best practices of managing and promoting entrepreneurship thinking and processes along with placing a special emphasis on innovation in existing and start-up organizations. Specifically, topics include leadership, strategy, design-driven innovation, business model innovation, knowledge management, information technology, change management, performance measurement, and process improvement will be covered throughout this course. In addition, a special emphasis is placed in funding techniques, frameworks and strategies, risks, business models, and innovation and entrepreneurship challenges and barriers.

MBA7304 – Accounting for Decision Making

In this course students will examine every aspect of cost data and how it relates to decision making, planning and control. More than just numbers and columns, accounting information can be an effective management tool if leveraged correctly. Students will gain insight into the versatility of this data as well as how accounting practices are evolving in manufacturing, service delivery technologies and more. Through this case study-oriented course, students will become familiar with the two basic types of product costing systems as well as the concept of cost flow. From how process costing measures the costs of direct labor, direct materials, and overhead costs for each process, department, or function, to value-based systems that help companies manufacture and deliver products and services while minimizing waste, Students will discover methods for improving operations and lowering costs.

MBA7405 – Human Resources Management

This course is an introduction to the human resource management (HRM) functions, related elements, and activities to examine the role of the human resource professional as a strategic partner in managing today's organizations. Even if your specialization is not HRM, this course gives you a strong grounding in the key HR functions that will assist you while managing, developing, supporting, and engaging your subordinates. Key functions such as recruitment, selection, development, appraisal, retention, compensation, and labour relations are examined. Implications of legal and global environments are appraised and current issues such as diversity training, employee engagement, and the rising cost of benefits are analyzed. Emphasis is placed on the strategic and modern-day importance of HRM at the corporate level as well as the view of HRM from the perception of both management and subordinate employees. Emphasis will be placed on these practices as they apply to the current Jordanian employment environment.

MBA7900 – Marketing Management

Marketing Management is the art and science of choosing target markets and getting, keeping, and growing customers through creating, delivering, and communicating superior customer value as well as building profitable customers relationships on the long term. The marketing management process is important at all levels of the organisation, regardless of the title applied to the activity. Marketing management seeks to meet organisational objectives by effectively satisfying customers in a dynamic environment. This course provides a solid foundation of marketing management, processes, strategic marketing, tactical marketing, and marketing implementation activities. Further, this course focuses on sales management as well as ethical practices that

today's organisations practice as an essential part of marketing. Finally, it provides students with the opportunity to apply the key concepts in marketing to practical business situations.

LOGS732 – Supply Network Design and Optimization

This module examines the key issues that companies must address in designing a supply network and the theories underpinning this; the practice of supply network design and optimization; as well as awareness of the tradeoffs involved in the optimization of logistical networks. Optimized supply network leads to minimum total system costs and hence enhance profitability and competitiveness. It outlines the essential concepts to understand the different types of supply chains and discusses how different supply chains can be designed for different products.

LOGS724 – Warehousing & Inventory Management

This course covers two Topics. The inventory part aims to introduce the students to the fundamental nature of inventory from a financial, physical, forecasting, and operational standpoint. The ultimate goal of this course is to present immediately usable information in the areas of forecasting, physical control and layout, and problem recognition and resolution. The warehouse part is designed to help students to understand warehouse functions, processes, organization and operations. It includes analysis of warehouse location, operation, management, controls, procedures, finance, security, cargo/materials handling, and productivity.

MBA7905 – Total Quality Management

This course introduces the concept of Total Quality Management; its philosophies, theories, and strategies as they apply to the business environment. The course will show the bases of all quality theories as well as its application in a form of performance improvement initiatives. Deployment strategies can be applied to typical businesses in a public and private sectors of the economy. In this course we discuss pillars of TQM, concepts of quality gurus, quality models such as Malcolm Baldrige National Quality Award (MBNQA), European Foundation of Quality Management (EFQM), and Deming's Prize. The course also discusses numerous quality tools, quality trends and ISO 9001.

3. Thesis/Comprehensive Exam/Other

PCE7991, PCE7992, PCE7993

9 Cr Hr

The Master thesis should demonstrate the student's ability to conduct independent research in pharmaceutical and chemical engineering, integrating scientific, technological, and regulatory knowledge. It should show competence in defining and addressing complex problems related to process design, formulation development, biopharmaceutical production, or sustainable manufacturing. The student is expected to apply appropriate experimental, analytical, or modeling methods, critically interpret results, and present findings in a well-structured written thesis and oral defense before an examination committee.
