

Course Specification: Perfusion Equipment and Maintenance (CPPM 706)

I. General Information

Field	Details
1. Course Title	Perfusion Equipment and Maintenance
2. Course Code	CPPM 706
3. Credit Hours	3
4. Contact Hours	4.5 (2 Theoretical + 2.5 Practical / Laboratory)
5. Level / Semester	Master's / Second Semester
6. Prerequisite	Fundamentals of Cardiac Perfusion (CPPM 702)
7. Program(s)	Master of Cardiopulmonary Perfusion
8. Language of Instruction	English
9. Prepared by	—
10. Date of Approval	October 2025

II. Course Description

This advanced technical course provides comprehensive knowledge and practical skills in the operation, calibration, and maintenance of cardiopulmonary perfusion equipment used in clinical and research settings.

Students will study the design, function, and safety aspects of essential perfusion systems, including pumps, oxygenators, heat exchangers, reservoirs, filters, sensors, and monitoring devices.

The course emphasizes preventive maintenance, troubleshooting, and quality control procedures to ensure safe, effective, and reliable operation during cardiopulmonary bypass (CPB).

Hands-on sessions train students in assembly, priming, de-airing, performance testing, and emergency management of perfusion equipment.

By the end of the course, students will be capable of managing equipment functionality in accordance with international standards and institutional safety protocols.

III. Course Intended Learning Outcomes (CILOs)

Domain	Intended Learning Outcomes (CILOs)	Referenced PILO
A. Knowledge and Understanding	a1. Describe the design principles and operating mechanisms of perfusion systems and auxiliary devices.	M/A (A1)
	a2. Explain the standards of calibration, performance testing, and maintenance schedules for perfusion equipment.	M/A (A2)
	a3. Identify the causes of common mechanical and electronic failures in CPB systems and corrective actions.	M/A (A3)
B. Intellectual Skills	b1. Analyze device performance data and evaluate the impact of malfunction on patient safety.	M/A (B1)
	b2. Apply problem-solving skills in diagnosing and resolving equipment-related issues under simulated clinical conditions.	M/A (B2)
C. Professional and Practical Skills	c1. Demonstrate the ability to assemble, inspect, and test perfusion equipment according to standard operating procedures (SOPs).	P (C1)
	c2. Perform preventive and corrective maintenance using manufacturer guidelines and biomedical principles.	P (C2)
D. Transferable Skills	d1. Document equipment checks, maintenance logs, and calibration reports accurately and professionally.	M (D1)
	d2. Adhere to infection control, occupational safety, and biomedical ethics during equipment handling and maintenance.	M (D3)

IV. Course Contents

Main Topic	Subtopics	Weeks	Hours	Aligned CILOs
1. Introduction to Perfusion Equipment	Overview of perfusion systems, classification, safety regulations, international standards (ISO, ASTM).	1–2	4	a1
2. Pumps and Flow Systems	Roller and centrifugal pumps, calibration, flow dynamics, troubleshooting.	3–4	4	a1, b2
3. Oxygenators and Gas Exchange Units	Membrane types, function, testing of O ₂ /CO ₂ exchange efficiency, resistance control.	5–6	4	a1, c1
4. Heat Exchangers, Reservoirs, and Filters	Function, maintenance, leakage testing, compatibility with CPB circuits.	7–8	4	a2, c2
5. Monitoring and Control Systems	Pressure, temperature, flow, and gas analyzers; calibration and error sources.	9–10	4	a2, b1
6. Troubleshooting and Emergency Management	Detection and correction of system failures, air embolism prevention, backup systems.	11–12	4	b2, c1
7. Preventive Maintenance and Quality Control	SOPs, equipment logs, maintenance checklists, biomedical waste and safety protocols.	13	2	a3, c2, d1
8. Practical Demonstrations and Case Scenarios	Laboratory and simulation sessions; performance evaluation and presentation.	14	2	d1, d2

V. Teaching and Learning Methods

- Interactive lectures and audiovisual demonstrations
- Laboratory practice and simulation-based workshops
- Case-based troubleshooting exercises
- Guided equipment maintenance sessions
- Student presentations and group reports

VI. Assessment Methods

- Midterm Exam (30%)
- Practical/Lab Performance (30%)
- Final Written Exam (30%)
- Participation & Continuous Assessment (10%)

VII. Teaching and Learning Resources

Category	Resources
Core Textbooks	1. <i>Clinical Perfusion for Cardiac Surgery: A Step-by-Step Guide to the Fundamentals</i> by James DiNardo (2025). Springer. 2. <i>Cardiopulmonary Bypass: Principles and Practice</i> by Gravlee, G. P. (Latest Edition). Wolters Kluwer.
Supplementary Texts	1. <i>Perfusion Technology: Equipment and Techniques</i> (Latest Edition). Elsevier. 2. <i>Biomedical Instrumentation and Maintenance Handbook</i> (Latest Edition). CRC Press.
Journals & Databases	<i>Journal of ExtraCorporeal Technology (JECT)</i> , <i>Perfusion</i> , <i>Annals of Thoracic Surgery</i> , <i>PubMed</i> , <i>Scopus</i> .