

## Course Specifications for First Semester - Master of Cardiopulmonary Perfusion

Program Based on the CAQA-Yemen Course Specification Template

### 1. Course Specification: Advanced Cardiovascular Physiology and Anatomy (CPPM 701)

#### I. General Information:

Field	Details
1. Course Title	Advanced Cardiovascular Physiology and Anatomy
2. Course Code	CPPM 701
3. Credit Hours	3
4. Contact Hours	4.5 (3 Theoretical + 1.5 Practical)
5. Level/ Semester	Master's / First Semester
6. Prerequisite (if any)	None (Foundational Course)
7. Program(s) in which the Course is Offered	Master of Cardiopulmonary Perfusion
8. Language of Teaching the Course	English
9. Prepared by	
10. Date of Approval	October 2025

#### II. Course Description:

This advanced course provides a comprehensive and in-depth study of the anatomical structures and physiological functions of the cardiovascular system, with a specific focus on aspects critical to cardiopulmonary perfusion. The course covers cellular electrophysiology, advanced hemodynamics, pulmonary circulation, and the pathophysiology of major cardiac and vascular diseases, preparing students to understand the physiological basis of cardiopulmonary bypass (CPB) and related interventions.

### III. Course Intended Learning Outcomes (CILOs):

CILOs	Referenced PILOs (I, P, M/A)
<b>A. Knowledge and Understanding:</b>	
a1 Describe the intricate anatomical structures of the heart, coronary circulation, and major blood vessels relevant to surgical cannulation and CPB.	M/A (A1)
a2 Explain the advanced physiological mechanisms of myocardial contraction, cellular electrophysiology, and the regulation of cardiac output and blood pressure.	M/A (A2)
a3 Demonstrate a broad understanding of the pathophysiology of common cardiac conditions and their impact on perfusion.	M/A (A3)
<b>B. Intellectual Skills:</b>	
b1 Analyze complex physiological data to assess cardiac function and the need for mechanical support.	M/A (B1)
b2 Interpret the physiological consequences of CPB (e.g., hemodilution, hypothermia, inflammatory response) to guide perfusion management decisions.	M/A (B2)
<b>C. Professional and Practical Skills:</b>	
c1 Apply anatomical knowledge to identify and verify sites for monitoring and cannulation in simulated CPB scenarios.	P (C1)
c2 Demonstrate the ability to interpret advanced diagnostic data such as ECGs and cardiac catheterization reports.	P (C2)
<b>D. Transferable Skills:</b>	
d1 Communicate effectively using specialized medical and physiological terminology with the surgical and perfusion team members.	M (D1)

d2 Engage in self-directed learning and critical appraisal of scientific literature related to cardiovascular physiology.	M (D3)
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#### IV. Course Contents:

Main Topic	Subtopics	Week	Hours	Aligned CILOs
<b>1. Foundational Anatomy &amp; Electrophysiology</b>	Review of Basic Anatomy, Coronary Circulation, Conduction System, Cellular Electrophysiology.	1-3	6	a1, a2, c2
<b>2. Advanced Hemodynamics &amp; Regulation</b>	Starling's Law, Pressure-Volume Loops, Regulation of Cardiac Output, Neuro-Hormonal Control, Mechanisms of Shock.	4-6	6	a2, b1
<b>3. Pathophysiology of Heart Disease</b>	Heart Failure, Valvular Heart Diseases, Coronary Artery Disease, Congenital Defects.	7-9	6	a3, b2
<b>4. Applied Physiology for CPB</b>	Pulmonary Circulation, Physiological Effects of Hypothermia/Rewarming, Systemic Inflammatory Response to CPB.	10-12	6	a2, b2, d2
<b>5. Organ Protection &amp; Mechanical Support</b>	Myocardial Protection (Physiological Basis), Cerebral Perfusion, Principles of Mechanical Circulatory Support (VADs, ECMO).	13-14	4	a3, b1, d1

#### V. Teaching and Learning Resources:

Category	Resources
<b>Core Textbooks</b>	1. <b>Berne &amp; Levy Physiology</b> (Latest Edition). <i>Elsevier</i> . 2. <b>Ganong's Review of Medical Physiology</b> (Latest Edition). <i>McGraw Hill</i> .
<b>Supplementary Texts</b>	1. <b>Advanced Cardiovascular Exercise Physiology</b> (Latest Edition). <i>Human Kinetics</i> . 2. <b>Clinical Perfusion for Cardiac Surgery: A Step-</b>



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	<b>by-Step Guide to the Fundamentals</b> by James DiNardo (2025). <i>Springer</i> .
<b>Journals &amp; Databases</b>	Journal of ExtraCorporeal Technology (JECT), Circulation, American Journal of Physiology, PubMed, Scopus.

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## 2. Course Specification: Fundamentals of Cardiac Perfusion (CPPM 702)

### I. General Information:

Field	Details
1. Course Title	Fundamentals of Cardiac Perfusion
2. Course Code	CPPM 702
3. Credit Hours	3
4. Contact Hours	4.5 (3 Theoretical + 1.5 Practical)
5. Level/ Semester	Master's / First Semester
6. Prerequisite (if any)	Advanced Cardiovascular Physiology and Anatomy (CPPM 701) - <i>Suggested</i>
7. Program(s) in which the Course is Offered	Master of Cardiopulmonary Perfusion
8. Language of Teaching the Course	English
9. Prepared by	
10. Date of Approval	October 2025

### II. Course Description:

This core course introduces the fundamental principles, equipment, and clinical practices of cardiopulmonary bypass (CPB). Students will gain a deep understanding of the CPB circuit components, anticoagulation management, myocardial protection strategies, and the physiological management of the patient during CPB. The course emphasizes the practical skills required for safe and effective perfusion delivery.

### III. Course Intended Learning Outcomes (CILOs):

CILOs	Referenced PILOs (I, P, M/A)
<b>A. Knowledge and Understanding:</b>	
a1 Describe the function, operation, and maintenance of all components of the CPB circuit.	M/A (A1)
a2 Explain the procedures for safe initiation, maintenance, and termination of cardiopulmonary bypass.	M/A (A2)
a3 Demonstrate knowledge of different myocardial protection techniques and solutions (Cardioplegia).	M/A (A3)
<b>B. Intellectual Skills:</b>	
b1 Analyze and interpret patient physiological and hematological data to make immediate adjustments during CPB.	M/A (B1)
b2 Evaluate potential CPB complications and formulate rapid, effective management plans.	M/A (B2)
<b>C. Professional and Practical Skills:</b>	
c1 Demonstrate the ability to assemble, prime, and de-air the CPB circuit in a simulated environment.	M (C1)
c2 Apply protocols for anticoagulation management, including accurate calculation and administration of Heparin and Protamine.	M (C2)
<b>D. Transferable Skills:</b>	
d1 Collaborate effectively with the surgical, anesthesia, and nursing teams, maintaining clear communication.	M (D1)
d2 Maintain accurate and detailed perfusion records and documentation according to professional standards.	P (D3)

#### IV. Course Contents:

Main Topic	Subtopics	Week	Hours	Aligned CIOs
<b>1. Introduction to CPB</b>	History, Indications, Contraindications, Types of Circuits, Cannulation Techniques.	1-2	4	a1, a2
<b>2. CPB Components</b>	Pumps (Roller/Centrifugal), Oxygenators, Heat Exchangers, Reservoirs, Filters.	3-4	4	a1
<b>3. Anticoagulation Management</b>	Heparinization, Protamine Reversal, ACT Monitoring, Hemostasis and Blood Conservation.	5-6	4	a2, c2
<b>4. Myocardial Protection</b>	Principles of Cardioplegia, Solutions, Routes of Delivery, Ischemic Preconditioning.	7-9	6	a3, b1
<b>5. Patient Management During CPB</b>	Flow and Pressure Management, Temperature Control, Blood Gas and Acid-Base Management, Fluid and Electrolyte Balance.	10-12	6	a2, b1
<b>6. Complications and Emergencies</b>	Air Embolism, Pump Failure, Massive Bleeding, Management of Critical Incidents, Weaning from CPB.	13-14	4	b2, d1

#### V. Teaching and Learning Resources:

Category	Resources
<b>Core Textbooks</b>	1. <b>Clinical Perfusion for Cardiac Surgery: A Step-by-Step Guide to the Fundamentals</b> by James DiNardo (2025). <i>Springer</i> . 2. <b>Perfusion: A Quick Reference Guide</b> by John H. Artrip (Latest Edition). <i>Springer</i> .



<b>Supplementary Texts</b>	1. <b>Cardiovascular Perfusion: Protocols and Guidelines</b> (Latest Edition). 2. <b>The Essentials of Perfusion</b> by D. G. T. Jones (Latest Edition). <i>Elsevier</i> .
<b>Journals &amp; Databases</b>	Journal of ExtraCorporeal Technology (JECT), Perfusion, PubMed, Scopus.

### 3. Course Specification: Cardiac Pharmacology (CPPM 703)

#### I. General Information:

Field	Details
1. Course Title	Cardiac Pharmacology
2. Course Code	CPPM 703
3. Credit Hours	3
4. Contact Hours	4.5 (3 Theoretical + 1.5 Practical)
5. Level/ Semester	Master's / First Semester
6. Prerequisite (if any)	Advanced Cardiovascular Physiology and Anatomy (CPPM 701) - <i>Suggested</i>
7. Program(s) in which the Course is Offered	Master of Cardiopulmonary Perfusion
8. Language of Teaching the Course	English
9. Prepared by	
10. Date of Approval	October 2025

#### II. Course Description:

This course provides an in-depth study of the pharmacologic agents used in the management of cardiac patients, particularly in the perioperative and critical care settings. The focus is on the mechanisms of action, pharmacokinetics, pharmacodynamics, dosage calculation, and safe administration of vasoactive drugs, anticoagulants, antiarrhythmics, and agents used for myocardial protection during cardiopulmonary bypass.

### III. Course Intended Learning Outcomes (CILOs):

CILOs	Referenced PILOs (I, P, M/A)
<b>A. Knowledge and Understanding:</b>	
a1 Describe the mechanisms of action and physiological effects of major vasoactive drugs on the cardiovascular system.	M/A (A1)
a2 Explain the pharmacokinetics and pharmacodynamics of drugs when administered into the CPB circuit.	M/A (A2)
a3 Identify common drug interactions and adverse effects relevant to the cardiac surgical patient.	M/A (A3)
<b>B. Intellectual Skills:</b>	
b1 Analyze patient hemodynamic status and select the most appropriate pharmacological intervention to optimize perfusion.	M/A (B1)
b2 Evaluate the efficacy of administered drugs based on continuous patient monitoring data and adjust the therapeutic plan accordingly.	M/A (B2)
<b>C. Professional and Practical Skills:</b>	
c1 Accurately calculate drug dosages and prepare solutions for intravenous administration.	M (C1)
c2 Apply strict protocols for the safe handling and administration of high-alert medications in the operating room environment.	M (C2)
<b>D. Transferable Skills:</b>	
d1 Utilize smart infusion pump technology for precise drug delivery and demonstrate an understanding of medication safety systems.	M (D1)
d2 Communicate clearly and concisely the drug administration details and patient response to the anesthesia and surgical team.	P (D3)

#### IV. Course Contents:

Main Topic	Subtopics	Week	Hours	Aligned CILOs
<b>1. Pharmacological Principles in CPB</b>	Pharmacokinetics/Pharmacodynamics in Hemodilution, Drug Distribution in the CPB Circuit.	1-2	4	a2, c1
<b>2. Vasoactive Drugs</b>	Inotropes, Vasopressors, Vasodilators - Mechanisms and Dosing.	3-5	6	a1, b1
<b>3. Anticoagulation and Hemostasis</b>	Heparin, Protamine, Antifibrinolytics (TXA), Management of Coagulopathy and Bleeding.	6-7	4	a2, c2
<b>4. Drugs for Myocardial Protection</b>	Pharmacological Components of Cardioplegia Solutions, Adjunctive Agents.	9-10	4	a2, b1
<b>5. Antiarrhythmics and Anesthetics</b>	Mechanisms and Use of Antiarrhythmics, Basic Principles of Anesthetic Agents during CPB.	11-12	4	a1, a3
<b>6. Medication Safety and Emergency</b>	Drug Interactions, High-Alert Medications, Management of Cardiac Emergencies (ACLS drugs), Smart Pump Technology.	13-14	4	a3, b2, d1

#### V. Teaching and Learning Resources:

Category	Resources
<b>Core Textbooks</b>	1. <b>Goodman &amp; Gilman's The Pharmacological Basis of Therapeutics</b> (Latest Edition). <i>McGraw Hill</i> . 2. <b>Katzung &amp; Trevor's Basic &amp; Clinical Pharmacology</b> (Latest Edition). <i>McGraw Hill</i> .



<b>Supplementary Texts</b>	1. <b>Stoelting's Pharmacology &amp; Physiology in Anesthetic Practice</b> (Latest Edition). <i>Lippincott Williams &amp; Wilkins</i> . 2. <b>Clinical Perfusion for Cardiac Surgery: A Step-by-Step Guide to the Fundamentals</b> by James DiNardo (2025). <i>Springer</i> .
<b>Journals &amp; Databases</b>	Journal of Cardiothoracic and Vascular Anesthesia, Critical Care Medicine, PubMed, Scopus.

Republic of Yemen  
Ministry of Education & Scientific Research  
21 September University  
Faculty of High Nursing  
Master Degree of Cardiolopulmonary Perfusion Nursi



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كلية التمريض العالي  
برنامج التروية القلبية

#### 4. Course Specification: Research Methodology (CPPM 704)

##### I. General Information:

Field	Details
1. Course Title	Research Methodology
2. Course Code	CPPM 704
3. Credit Hours	3
4. Contact Hours	4.5 (3 Theoretical + 1.5 Research/Practical)
5. Level/ Semester	Master's / First Semester
6. Prerequisite (if any)	None (Mandatory Course)
7. Program(s) in which the Course is Offered	Master of Cardiopulmonary Perfusion
8. Language of Teaching the Course	English
9. Prepared by	
10. Date of Approval	October 2025

##### II. Course Description:

This course introduces master's students to the fundamental principles and methods of scientific research, with a focus on health sciences and cardiopulmonary perfusion. It covers the process of formulating research questions, selecting appropriate study designs, data collection, basic biostatistics, ethical considerations, and the development of a research proposal. The course aims to equip students with the necessary skills to critically appraise literature and conduct independent research.



### III. Course Intended Learning Outcomes (CILOs):

CILOs	Referenced PILOs (I, P, M/A)
<b>A. Knowledge and Understanding:</b>	
a1 Describe the different types of research designs (quantitative, qualitative, mixed methods) and their application in perfusion science.	M/A (A1)
a2 Explain the core principles of research ethics, including informed consent, confidentiality, and the role of the IRB.	M/A (A2)
a3 Identify the key components of a rigorous research proposal and scientific paper.	M/A (A3)
<b>B. Intellectual Skills:</b>	
b1 Formulate a clear, focused, and researchable question, hypothesis, and set of objectives for a study in the field of cardiopulmonary perfusion.	M/A (B1)
b2 Critically appraise published research articles to evaluate their methodology, results, and relevance to clinical practice (Evidence-Based Practice).	M/A (B2)
<b>C. Professional and Practical Skills:</b>	
c1 Conduct a systematic literature search using relevant databases and manage references effectively.	M (C1)
c2 Apply basic biostatistical tests (e.g., t-test, Chi-square) using statistical software (e.g., SPSS) to analyze simple data sets.	P (C2)
<b>D. Transferable Skills:</b>	
d1 Develop and present a preliminary research proposal following academic standards.	M (D1)
d2 Work effectively in a group to critique research and collaborate on proposal development.	P (D3)



#### IV. Course Contents:

Main Topic	Subtopics	Week	Hours	Aligned CIOs
<b>1. Introduction and Research Question</b>	Importance of Research, Types of Research, Formulating Problem, Objectives, and Hypotheses.	1-2	4	a1, b1
<b>2. Literature Review and Ethics</b>	Systematic Review Process, Reference Management, Research Ethics (IRB, Consent, Confidentiality).	3-4	4	a2, c1
<b>3. Research Designs</b>	Quantitative Designs (Descriptive, Analytical, Experimental - RCTs), Sampling Techniques (Size Calculation).	5-7	6	a1, b2
<b>4. Data Collection and Biostatistics</b>	Data Collection Tools, Validity/Reliability, Descriptive Statistics (Measures of Central Tendency/Dispersion).	9-10	4	c2
<b>5. Inferential Statistics</b>	Hypothesis Testing, T-Tests, Chi-Square Test, Correlation, ANOVA (Basic).	11-12	4	c2
<b>6. Research Proposal and Dissemination</b>	Proposal Structure, Budget, Timeline, Scientific Writing, Peer Review Process, Presenting Findings.	13-14	4	a3, d1

#### V. Teaching and Learning Resources:

Category	Resources
<b>Core Textbooks</b>	1. <b>Research Methodology in the Health Sciences: A Quick Reference Guide</b> by S. K. A. G. (2021). <i>McGraw Hill</i> . 2. <b>Introduction to Research in the Health Sciences</b> (7th Edition) by S. Polgar (Latest Edition). <i>Elsevier</i> .



<b>Supplementary Texts</b>	1. <b>Biostatistics: A Foundation for Analysis in the Health Sciences</b> (Latest Edition) by W. W. Daniel & J. C. Cross. <i>Wiley</i> . 2. <b>Designing Clinical Research</b> (Latest Edition) by S. B. Hulley. <i>Lippincott Williams &amp; Wilkins</i> .
<b>Journals &amp; Databases</b>	Journal of ExtraCorporeal Technology (JECT), The Lancet, NEJM, PubMed, Scopus.

## Course Specification: Cardiac Disorders (CPPM 705)

### I. General Information

Field	Details
1. Course Title	<b>Cardiac Disorders</b>
2. Course Code	<b>CPPM 705</b>
3. Credit Hours	<b>3</b>
4. Contact Hours	<b>4.5 (3 Theoretical + 1.5 Practical/Seminar)</b>
5. Level / Semester	Master's / First Semester
6. Prerequisite	Advanced Cardiovascular Physiology and Anatomy (CPPM 701)
7. Program(s) Offered	Master of Cardiopulmonary Perfusion
8. Language of Instruction	English
9. Prepared by	—
10. Date of Approval	October 2025

### II. Course Description

This course provides an advanced study of the etiology, pathophysiology, clinical manifestations, diagnostic approaches, and management of major cardiac disorders commonly encountered in cardiac surgery and perfusion practice.

It emphasizes the integration of pathophysiological knowledge with perfusion management strategies during cardiopulmonary bypass (CPB). Topics include ischemic heart disease, valvular heart diseases, cardiomyopathies, congenital heart defects, arrhythmias, heart failure, and inflammatory cardiac conditions.

Students will explore the impact of these disorders on hemodynamics, myocardial oxygen demand, and perfusion strategies, enabling evidence-based clinical decision-making in the operating room and intensive care unit.

### III. Course Intended Learning Outcomes (CILOs)

Domain	Intended Learning Outcome	Referenced PILO
<b>A. Knowledge and Understanding</b>	a1. Describe the pathophysiology and clinical features of major cardiac disorders relevant to perfusion management.	M/A (A1)
	a2. Explain the diagnostic methods (ECG, echocardiography, cardiac catheterization) used to evaluate cardiac function.	M/A (A2)
	a3. Discuss the effects of cardiac pathologies on perfusion parameters and surgical outcomes.	M/A (A3)
<b>B. Intellectual Skills</b>	b1. Analyze clinical case data to determine perfusion implications of specific cardiac diseases.	M/A (B1)
	b2. Correlate diagnostic findings with physiological changes to plan optimal perfusion strategies.	M/A (B2)
<b>C. Professional and Practical Skills</b>	c1. Interpret real patient diagnostic data (e.g., ECG, echo reports) and recognize critical abnormalities.	P (C1)
	c2. Apply knowledge of disease-specific perfusion requirements in simulated or case-based scenarios.	P (C2)
<b>D. Transferable Skills</b>	d1. Communicate effectively with multidisciplinary cardiac teams using appropriate clinical terminology.	M (D1)
	d2. Engage in self-directed learning and critically evaluate recent research on cardiac diseases and perfusion.	M (D3)

#### IV. Course Contents

Main Topic	Subtopics	Weeks	Hours	Aligned CILOs
1. Introduction to Cardiac Pathophysiology	Overview of cardiac disease classification, hemodynamic principles, and diagnostic approaches	1–2	4	a1, a2
2. Ischemic Heart Disease	Coronary artery disease, myocardial ischemia/infarction, revascularization procedures	3–4	4	a1, b1
3. Valvular Heart Diseases	Aortic, mitral, tricuspid, and pulmonary valve disorders; surgical implications	5–6	4	a1, a3
4. Cardiomyopathies and Heart Failure	Types, mechanisms, compensatory responses, perfusion considerations	7–8	4	a1, b2
5. Congenital Heart Diseases	Common defects (ASD, VSD, TOF, TGA); pediatric vs. adult considerations	9–10	4	a2, c2
6. Cardiac Arrhythmias	Mechanisms, clinical implications, perioperative management	11–12	4	a2, c1
7. Inflammatory and Infective Disorders	Endocarditis, myocarditis, pericarditis, rheumatic heart disease	13	2	a1, b1
8. Integration and Case Discussions	Case presentations and clinical correlation seminars	14	2	d1, d2

#### V. Teaching and Learning Methods

- Interactive lectures and multimedia presentations
- Case-based learning and seminars



- Problem-solving workshops using clinical data
- Simulation-based training and ECG interpretation sessions
- Guided journal reviews

## VI. Assessment Methods

- Midterm Examination (30%)
- Case/Research Presentation (20%)
- Final Examination (40%)
- Participation and Continuous Assessment (10%)

## VII. Teaching and Learning Resources

Category	Resources
<b>Core Textbooks</b>	1. <i>Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine</i> (Latest Edition). Elsevier. 2. <i>Pathophysiology of Heart Disease</i> by Lilly L. S. (Latest Edition). Wolters Kluwer.
<b>Supplementary Texts</b>	1. <i>Clinical Perfusion for Cardiac Surgery: A Step-by-Step Guide to the Fundamentals</i> by James DiNardo (2025). Springer. 2. <i>Cardiac Surgery in the Adult</i> by Cohn L. (Latest Edition). McGraw Hill.
<b>Journals &amp; Databases</b>	<i>Journal of ExtraCorporeal Technology (JECT), Circulation, Perfusion, PubMed, Scopus.</i>

## 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
<b>A. Knowledge and Understanding</b>	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>B. Intellectual Skills</b>	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)
<b>C. Professional and Practical Skills</b>	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)
<b>D. Transferable Skills</b>	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 <sub>2</sub> /CO <sub>2</sub> 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
<b>Core Textbooks</b>	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.
<b>Supplementary Texts</b>	1. <i>Perfusion Technology: Equipment and Techniques</i> (Latest Edition). Elsevier. 2. <i>Biomedical Instrumentation and Maintenance Handbook</i> (Latest Edition). CRC Press.
<b>Journals &amp; Databases</b>	<i>Journal of ExtraCorporeal Technology (JECT)</i> , <i>Perfusion</i> , <i>Annals of Thoracic Surgery</i> , <i>PubMed</i> , <i>Scopus</i> .