



SYLLABUS WITH REFERENCES - EXAM 2025

PART I: BASIC SCIENCES & PART II: APPLIED PERFUSION TECHNOLOGY

PART I: BASIC SCIENCES

HUMAN ANATOMY

I. CELL BIOLOGY AND HISTOLOGY

- 1. Cell** : - Organelles: Structure & function, Plasma membrane: Structure, transport mechanisms, Cell cycle: Mitosis, meiosis, regulation. , Mutations: Types & significance
- 2. Tissues** : Epithelial : Types, structure, function. , Connective : Types, components. , Muscle : Skeletal, cardiac, smooth. , Nervous : Neurons & support cells. , Healing: Regeneration & repair. , Membranes & Glands: Classification, roles

Reference Texts:

- Ross & Pawlina: **Histology: A Text and Atlas , 8th ed., 2020**
- Alberts et al.: **Molecular Biology of the Cell , 7th ed., 2022**

II. CARDIOVASCULAR SYSTEM

- 1. Heart** : Position, pericardial coverings, Chambers, valves, internal/external features, Coronary circulation (arterial & venous), Conducting system, Autonomic innervation (sympathetic & parasympathetic)
- 2. Circulation** : Pulmonary, systemic & portal pathways , Major arteries and veins (overview)

Reference Texts:

- Moore & Dalley: **Clinically Oriented Anatomy , 8th ed., 2017**
- Gray's Anatomy for Students, 4th ed., 2019

III . RESPIRATORY SYSTEM

Airway Anatomy : Trachea, bronchi, bronchioles. , Lungs & Pleura: Structure, lobes, pleural cavity. , Respiratory Mechanics & Gas Exchange., Nerve Supply.

Reference Texts:

- Snell: **Clinical Anatomy by Regions , 10th ed., 2018**
- West: **Respiratory Physiology: The Essentials , 11th ed., 2020**

IV. NERVOUS SYSTEM

- 1. Central Nervous System (CNS)** : Brain: divisions, coverings (meninges). , Cerebrum: lobes, cortex, white matter, basal ganglia. , Brainstem: midbrain, pons, medulla. , Cerebellum: structure and function. , Spinal cord: gross anatomy, tracts, meninges.
- 2. PERIPHERAL NERVOUS SYSTEM (PNS)**: Spinal nerves: origin, plexuses, thoracic nerves and intercostal spaces;; Cranial nerves: origin, course, functions
- 3. Autonomic Nervous System (ANS)**: Sympathetic and parasympathetic systems: organization, distribution

Reference Texts:

- Snell: **Neuroanatomy ,8th ed., 2021**

- Haines: **Fundamental Neuroscience for Basic and Clinical Applications** , 6th ed., 2023

V. URINARY SYSTEM

1. **Kidneys:** external and internal anatomy, Nephron structure and function

2. **Ureters:** course and structure

3. **Urinary bladder:** anatomy and histology

4. **Urethra:** male and female differences

Reference Texts:

- Moore & Persaud: **The Developing Human: Clinically Oriented Embryology** , 11th ed., 2020

- Tortora & Derrickson: **Principles of Anatomy and Physiology** , 16th ed., 2021

VI. ENDOCRINE SYSTEM

Pituitary gland and hypothalamic control. , Thyroid gland: anatomy and hormones. , Adrenal glands: cortex and medulla. , Pancreatic islets (Islets of Langerhans) .

Reference Texts:

- Young & O'Dowd: **Wheater's Functional Histology** , 6th ed., 2020

- Barrett et al.: **Ganong's Review of Medical Physiology** , 26th ed., 2019

RECOMMENDED GENERAL TEXTS

- *Gray's Anatomy for Students, Elsevier, 4th ed., 2019*

- *Tortora & Derrickson: Principles of Anatomy and Physiology, Wiley, 16th ed., 2021*

- *Snell Clinical Anatomy, Wolters Kluwer, 10th ed., 2018- Guyton & Hall: Textbook of Medical Physiology, 14th ed., 2020 (for integrated understanding)*

HUMAN PHYSIOLOGY

I. Circulatory Body Fluids & Hematology

Blood composition & function, Hematopoiesis / Bone marrow biology, Leukocytes, erythrocytes, platelets — structure & role, Blood groups and typing, Transfusion principles & compatibility, Plasma, colloids, and oncotic pressure, Coagulation factors & coagulation cascade, Immunity & homeostatic mechanisms.

II. Cardiovascular Physiology

Pacemaker: origin of heartbeat, action potentials. , Electrical conduction: SA node → AV node → His → Purkinje. , ECG: leads, rhythms, arrhythmias. ,Cardiac mechanics: heart as pump, stroke volume, pressures. ,Hemodynamics: cardiac output, systemic vascular resistance. , Regulatory reflexes: vasomotor center, baroreceptors, chemoreceptors. ,Starling's law & cardiac metabolism., Regional circulations: cerebral + CSF, coronary, splanchnic, skin, placental/fetal

III. Respiratory Physiology

Pulmonary function: mechanics, diffusion, ventilation. , Gas transport: O₂, CO₂, dissociation curves. , Acid–base physiology: buffers, respiratory and metabolic imbalances. , Control of respiration: neural & chemical regulation.

IV. Endocrine Physiology (Concise Study)

Thyroid: synthesis, regulation, effects. , Pancreatic islets: insulin, glucagon, carbohydrate metabolism. , Adrenal: medullary & cortical hormones, stress response. , Pituitary: anterior & posterior hormones, integrative control.

V. Temperature Regulation

Thermoregulatory mechanisms: heat production, dissipation, feedback controls.

VI. Renal / Excretory Physiology

Renal circulation & filtration. , Glomerular filtration dynamics. , Tubular functions: reabsorption, secretion, acid–base., Electrolyte regulation & diuretics. Renal function tests & interpretation. , Micturition reflex and control.

RECOMMENDED REFERENCES: Guyton & Hall: Textbook of Medical Physiology , 14th ed., 2020

- Ganong's Review of Medical Physiology , 26th ed., 2019

- Boron & Boulpaep: Medical Physiology , 3rd ed., 2020

- Vander's: Human Physiology: The Mechanisms of Body Function , 16th ed., 2021.

BIOCHEMISTRY

I. Basic Concepts & Laboratory Fundamentals

- Introduction to biochemical laboratory apparatus
- Types and principles of chemical balances
- Units and concepts: atomic weight, molecular weight, valency
- Solution chemistry: Normality, Molarity, standard solutions
- Acids, bases, and salts – definitions and reactions
- Acid–base indicators, hydrogen ion concentration, buffer systems
- Use of pH meter and principles of pH measurement

II. Biomolecules & Metabolism

1. Carbohydrates

- Classification, structure, and biological significance
- Metabolism: glycolysis, TCA cycle, gluconeogenesis, glycogen metabolism
- Aerobic vs. anaerobic metabolism

2. Lipids

- Classification, structure, and biological roles
- β -oxidation, synthesis of fatty acids and cholesterol
- Lipoproteins and lipid transport

3. Proteins

- Amino acids: classification and structure
- Levels of protein structure
- Protein metabolism: transamination, deamination, urea cycle

4. Nucleic Acids : DNA and RNA: structure, types, and biological function

- Basics of replication, transcription, translation

III. Energy & Functional Biochemistry

- Overview of bioenergetics and ATP generation
- Mitochondrial function and oxidative phosphorylation

IV. Clinical Biochemistry

- Liver Function Tests (LFTs) – parameters and interpretation
- Biochemical cardiac markers – Troponins, CK-MB, LDH, Myoglobin
- Hormonal evaluation: thyroid, insulin, cortisol, adrenal hormones

RECOMMENDED REFERENCE BOOKS

- Harper's Illustrated Biochemistry , 32nd Ed., 2022

- Lippincott's Illustrated Reviews: Biochemistry , 7th Ed., 2021
- Biochemistry by U. Satyanarayana, 5th Ed., 2020

MICROBIOLOGY

I. Theory

1. Introduction to Microbiology

Historical developments and contributions, Scope and applications in health sciences

2. Classification of Microorganisms

Overview of taxonomy: bacteria, viruses, fungi, protozoa. , Nomenclature and modern classification systems.

3. Bacterial Cell Structure

Morphology, anatomy and function of cell components. , Comparison between Gram-positive and Gram-negative bacteria.

4. Antimicrobial Agents and Resistance

Mechanism of action of antibiotics and chemotherapeutic agents. , Principles of drug resistance and clinical implications. , Disinfection and antisepsis – methods and agents

5. Sterilization Techniques

Physical and chemical methods. , Indicators and monitoring of sterilization. , Applications in clinical and laboratory settings

II. Practical (Bacteriology)

1. Microscopy & Morphology

Bacterial shape, arrangement, and structure under microscope. , Use of hanging drop method for motility observation.

2. Staining Techniques

- Simple staining procedure and interpretation
- Introduction to Gram stain and its clinical relevance (optional extension)

RECOMMENDED REFERENCE BOOKS

1. Ananthanarayan and Paniker's Textbook of Microbiology – 12th Edition, 2023
2. Medical Microbiology by Jawetz, Melnick & Adelberg – 28th Edition, 2022
3. Textbook of Microbiology by R. Ananthanarayan – latest Indian edition
4. Bailey & Scott's Diagnostic Microbiology – 14th Edition, 2021

Fundamentals of Perfusion Science

I. Operating Room Protocols & Practices

Orientation to the OR layout and aseptic zones (sterile, sub-sterile, unsterile areas), Standard protocols and workflow in the OR, Hand hygiene: Surgical scrubbing, gloving, and gowning, Sterile techniques and maintenance of sterile field, Handling and disposal of medical disposables.

II. Equipment Handling & Safety

Introduction to key equipment in the OR, Principles of equipment maintenance and operational checks.

Electricity in the OR: Basics of electrical safety, earthing, leakage currents, Static electricity and precautions with flammable agents.

Electromedical devices: Operating principles and safety safeguards

III. Biomedical Waste & Infection Control

Biomedical waste: Classification, segregation, color coding, Legal framework and disposal protocols.

Sterilization: Materials, methods (autoclaving, ETO, plasma), indicators.

IV. Cardiopulmonary Resuscitation & Emergency Protocols

Basic Life Support (BLS): Adult and pediatric algorithms., Advanced Cardiac Life Support (ACLS): Airway, defibrillation, pharmacology. , Code Blue response and crash cart protocols, Concepts of the Intensive Coronary Unit (ICU) and Recovery Room

V. Introduction to Cardiopulmonary Bypass (CPB)

Components of the CPB circuit: Pumps, oxygenators, heat exchangers, filters. , Overview of perfusionist's role in cardiac surgery, Basics of initiating and weaning from CPB .

RECOMMENDED REFERENCE BOOKS

1. Mishra, P. K. , Introduction to Perfusion Technology , 2nd Ed., Jaypee, 2021
2. Gravlee GP et al., Cardiopulmonary Bypass: Principles and Practice , 4th Ed., Wolters Kluwer, 2022
3. Standards and Guidelines for Perfusion Practice , American Society of Extracorporeal Technology (AmSECT), Latest Edition, 2023
4. Kumar & Clark's Clinical Medicine , 10th Ed., Elsevier, 2020 – CPR and ICU chapters
5. WHO Guidelines on Hand Hygiene in Health Care ,2nd Ed., 2021 .

Applied Pathology

I. Cardiovascular System Pathology

- Atherosclerosis: Pathogenesis, risk factors, complications
- Hypertension : Essential and secondary, vascular effects
- Aneurysms : Classification, pathophysiology, clinical relevance
- Heart Failure : Pathophysiological mechanisms and classification
- Cardiomyopathy: Dilated, hypertrophic, restrictive types
- Ischemic Heart Disease: Pathogenesis of angina, MI, complications
- Valvular Heart Diseases: Rheumatic, degenerative, infective causes
- Cardiac Tumors : Common benign and malignant types (e.g., myxoma)
- Congenital Heart Diseases : Obstructive (e.g., coarctation), Cyanotic (e.g., Tetralogy of Fallot), Acyanotic (e.g., VSD, ASD).
- Perfusion & Surgical Considerations : CPB techniques for pathological correction, Specific concerns in congenital, ischemic, and valvular surgeries
- Valvular Surgery : Indications, surgical principles
- Prosthetic Valves : Mechanical vs Bioprosthetic , selection criteria, complications

II. Hematology

Anemia : Classification, focus on hemolytic anemia and polycythemia. , Leukocyte Disorders : Leukocytosis, leukopenia, leukemia (brief overview).

Bleeding Disorders : Platelet disorders, Coagulation defects (Hemophilia, DIC)

Common Laboratory Tests : CBC, ESR, Coagulation profile, Peripheral smear

III. Respiratory System Pathology

Chronic Obstructive Pulmonary Disease (COPD). , Obstructive vs Restrictive Lung Diseases*: Comparative pathology. , Pulmonary Congestion & Edema : Causes, morphology, clinical relevance. , Pleural Effusion : Types, causes, diagnostic implications.

IV. Renal System Pathology

- Clinical Manifestations of Renal Disease : Hematuria, proteinuria, oliguria
- Acute Renal Failure (ARF) : Causes, pathogenesis, lab markers
- Chronic Renal Failure (CRF) : Etiology, progression, systemic effects

RECOMMENDED REFERENCE BOOKS

1. Robbins & Cotran Pathologic Basis of Disease , Authors: Kumar, Abbas, Aster, 10th Edition, Elsevier, 2021.
2. Essentials of Pathology for Allied Health Sciences, Author: Harsh Mohan, 1st Edition, Jaypee Brothers, 2020
3. Pathology Quick Review and MCQs, Author: Harsh Mohan, 4th Edition, 2022
4. Porth's Pathophysiology: Concepts of Altered Health States, Author: Sheila Grossman, 10th Edition, Lippincott Williams & Wilkins, 2023.

Applied Pharmacology

I. General Principles

Pharmacokinetics & Pharmacodynamics during CPB : Absorption, distribution, metabolism, elimination changes under CPB., Drug-hemodilution, hypothermia, organ perfusion interactions

II. Autonomic Nervous System

Neurotransmitters, receptors (adrenergic/cholinergic)., Drugs acting on ANS: agonists & antagonists

III. Cardiovascular Pharmacology

1. **Cardiovascular Drugs** : Inotropes, vasodilators, vasopressors, antiarrhythmics, beta-blockers, Drugs for ischemic heart disease, hypertension, heart failure.
2. **Cardioplegia Solutions** : History, principles of myocardial protection., Types: blood vs crystalloid; cold vs warm.
3. **Priming Fluids in CPB** : History, components, pharmacologic considerations.

IV. Anesthetic Pharmacology

General and local anesthetics. , Inhalational agents : Isoflurane, Sevoflurane. , IV anesthetics : Propofol, Etomidate, Ketamine.

V. Analgesics

Opioids and non-opioid analgesics, Mechanism of action., use in perioperative period .

VI. Antihistamines and Antiemetics

H1/H2 receptor blockers, Common antiemetics used in cardiac anesthesia

VII. CNS Stimulants and Depressants

Drugs affecting consciousness and respiration

VIII. Organ Protection in CPB

Pharmacologic strategies for neuroprotection, renal, hepatic, myocardial protection, Steroids, anesthetics, vasodilators.

IX. Inhalational Gases and Emergency Drugs

Oxygen, Nitric oxide, volatile agents. , Resuscitative agents: adrenaline, atropine, calcium, amiodarone, etc.

X. Respiratory Pharmacology

Drugs for asthma, COPD, pulmonary hypertension, Bronchodilators, steroids, mucolytics.

XI. Corticosteroids

Classification, mechanisms, perioperative uses.

XII. Diuretics

Loop, thiazide, potassium-sparing, Role during fluid management and bypass

XIII. Antimicrobial Agents

Common antibiotics in cardiac surgery, Prophylaxis and resistance concerns

XIV. Miscellaneous Pharmacology

- IV Fluids : Crystalloids, colloids – composition and usage
- Electrolyte Supplements : Na⁺, K⁺, Mg²⁺, Ca²⁺ preparations
- Immunosuppressive Drugs : Indications post-transplant
- Drugs for Electrolyte/Metabolic Imbalance
- Recent Drugs in Perfusion Practice : Dexmedetomidine, levosimendan, NO donors

RECOMMENDED REFERENCE BOOKS:

1. Rang & Dale's Pharmacology , Authors: H.P. Rang, J.M. Ritter, 10th Edition, Elsevier, 2023
2. Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 14th Edition, McGraw-Hill, 2022
3. Katzung's Basic and Clinical Pharmacology, 15th Edition, Lange, McGraw-Hill, 2021
4. Pharmacology for Anaesthesia and Intensive Care, Author: T.E. Peck, S.A. Hill, 5th Edition, Cambridge University Press, 2020
5. Textbook of Perfusion Technology, ,Author: Ghosh et al., Jaypee Brothers, 2nd Edition, 2022.

EXAM 2025 PART-B : APPLIED PERFUSION TECHNOLOGY

INTRODUCTION/FOUNDATION OF PERFUSION SCIENCE

I. Diagnostic & Preoperative Techniques

Chest X- ray, Electrocardiogram (ECG): lead systems, common findings. , Echocardiography: basic modalities & indications. , Angiography & coronary imaging. , Nuclear cardiology: principles, usage. , Laboratory investigations relevant to perfusion (e.g. CBC, electrolytes, ABG, coagulation), Pre- CPB surgery planning & patient preparation. , Historical landmarks: Gibbon, Lillehei, Carrel, "Azygous flow" concept. , Non- CPB surgical techniques: hypothermic/non- hypothermic methods, Gross's "Well technique," controlled cross circulation.

II. Monitoring & Instrumentation

- Monitoring principles & instrumentation: ECG machines, pressure transducers, pumps, ventilators, oximetry, thermometry, defibrillators.
- Gas delivery systems: piped vs non- piped, connections, safety
- Hemodynamic monitoring: pressures, flows, cardiac output
- Hemostatic & hematologic monitoring: ACT, TEG, blood cell counts- Acid-base, O₂/CO₂ control & monitoring
- Neurological monitoring: EEG, cerebral function monitors, SSPE
- Aseptic technique in the OR.

- Roles: cardiac surgery team, perfusionist scope & terminology

III. Physiology & Materials of Extracorporeal Circulation

- Principles of extracorporeal circulation, Circuit materials & biocompatibility.
- Gas exchange in oxygenators: bubble, spiral/cylinder, membrane types; defoaming, rated flows, diffusion principles.
- Blood pumps: ideal characteristics, pulsatile vs non- pulsatile, occlusive & non- occlusive; roller, bellows, diaphragm, centrifugal, ventricular types.
- Hazards in extracorporeal systems: blood damage, bubbles, heat exchangers, flow meters, regulating devices.
- Heat exchangers: design, temperature control.

IV. Circuit Connections & Management

- Vascular access: arterial & venous cannulae, connectors, tubing
- Auxiliary circuits: vents, suckers
- Cardioplegia delivery systems and venting strategies
- Hemodynamics of arterial return, venous drainage, cardioplegia delivery
- Blood banking and component management in perfusion context

RECOMMENDED REFERENCE BOOKS

1. Gravlee, G.P., et al. **Cardiopulmonary Bypass: Principles and Practice** , 4th Edition, Wolters Kluwer, 2022.
- Ghosh, B., **Textbook of Perfusion Technology** ,2nd Edition, Jaypee Brothers, 2022
3. **AmSECT Standards & Guidelines for Perfusion Practice** , latest edition (2023)
4. **Stoelting & Hillier** , **Pharmacology and Physiology for Anesthesia** , 7th Edition, 2020 (for monitoring & pharmacologic adjuncts) .

Perfusion Readiness: Ethics, Law, and Scientific Basis

I. Medical Ethics & Medico-Legal Aspects in Cardiac Care

- Principles of medical ethics: autonomy, beneficence, non-maleficence, justice
- Informed consent in high-risk procedures (CPB, ECMO, transplantation)
- Ethical/legal issues: DNR orders, device failures, blood transfusion, organ donation
- Medico-legal responsibilities: documentation, reporting, accountability
- Ethical challenges: Jehovah's Witnesses, fetal/neonatal surgeries, end-of-life care

RECOMMENDED TEXTBOOK:

"Medical Ethics and Law for the Health Professions"– Tony Hope, Judith Hendrick, Rebecca Baum. 4th Edition, 2020. Oxford University Press.

II. Biostatistics and Research Basics

Importance of statistics in evidence-based perfusion practice, Data types and collection methods. , Descriptive statistics: Mean, Median, Mode, SD. , Inferential statistics: t-test, chi-square, p-value. , Interpretation of clinical research and outcomes in perfusion science. , Application in clinical audits and quality assurance.

III. Basics of Computer Applications in Healthcare

IV. Electricity, Electromedical Equipment & Safety Protocols

- Basic electrical principles and circuits
- Static electricity and electromagnetic interference
- Safe use of electromedical equipment (CPB machine, defibrillator, ventilators)
- Grounding, isolation, and leakage current safety
- Preventive maintenance and biomedical engineering liaison

V. Biomedical Waste Management

- - Classification of biomedical waste (liquid, solid, sharps, etc.)
- - Segregation, collection, transport, and disposal protocols
- - Color coding and labeling systems
- - Regulatory guidelines (e.g., WHO, CPCB India)
- - Infection control in perfusion and surgical environments

VI. Cardiopulmonary Resuscitation (CPR)

- - Basic Life Support (BLS): Adult, pediatric, neonatal protocols
- - Advanced Cardiac Life Support (ACLS): Airway, drugs, defibrillation
- - Role of perfusionist in CPR and during code blue situations
- - Extracorporeal CPR (E-CPR) basics

VII. ICU, Recovery & Sterilization Concepts

- - Intensive Coronary Care Unit (ICCU) and recovery room protocols
- - Infection control measures, equipment handling
- - Sterilization methods: autoclaving, gas, chemical, plasma sterilization
- - Aseptic techniques in the OR

VIII. Blood Transfusion and Fluid Therapy

- - Indications, cross-matching, and components of transfusion
- - Transfusion reactions and management
- - Fluid types: crystalloids, colloids, albumin, blood products
- - Intraoperative volume replacement strategies

IX. Autotransfusion and Cell Salvage

- - Indications for cell salvage in cardiac surgery
- - Mechanism and setup of intraoperative cell salvage systems
- - Advantages and limitations
- - Safety, contraindications, and quality control

RECOMMENDED Reference Books

1. "Principles of Medical Ethics" – American Medical Association, Latest Ed.
2. Kishore J. – Medical Ethics & Law Simplified, 3rd Ed., Century Publications, 2021
3. Basu, S. – Biostatistics and Research Methodology, Jaypee, 2022

CLINICAL PERFUSION SCIENCE

1. Pharmacological Aspects of CPB

Pharmacokinetics and pharmacodynamics during cardiopulmonary bypass . , Drugs used in CPB: anesthetics, vasodilators, inotropes, anticoagulants .

2. Clinical Conduct of Cardiopulmonary Bypass

Setup, initiation, monitoring, and management of CPB. , Hemodynamic and metabolic monitoring during CPB. , Adequacy of perfusion: indicators, influencing factors, and critical parameters.

3. Pulsatile Perfusion

Theory and physiology of pulsatile vs non-pulsatile flow. , Hemodynamic, hematologic, and metabolic impacts. , Clinical application and limitations.

4. Cannulation Techniques

Arterial and venous cannulation approaches. ,Site-specific considerations and complications

5. Termination of CPB

Weaning strategies, rewarming protocols, volume management, Criteria for successful separation from bypass .

6. Myocardial Protection Strategies

Pretreatment of the myocardium. , Types of cardioplegia: cold, warm, blood, crystalloid- Hypothermia, controlled reperfusion, and non-cardioplegic methods. , Complications and myocardial protection in high-risk groups.

7. Oxygenation in CPB

Bubble vs membrane oxygenators. , Gas exchange principles and device assessment; Comparisons in clinical scenarios.

8. Heat Exchange in CPB

Principles and function of heat exchangers. , Efficiency, complications, and temperature control strategies.

9. Priming Fluids and Hemodilution

Types of priming fluids: crystalloid, colloid, blood. , Hemodilution and its physiological impact.

RECOMMENDED REFERENCE BOOKS

1. Gravlee, G. P., Davis, R. F., Stammers, A. H., Cardiopulmonary Bypass: Principles and Practice – 4th Edition, 2021, Lippincott Williams & Wilkins

2. Khonsari, S. & Sintek, C., **Cardiac Surgery: Safeguards and Pitfalls in Operative Technique*** – 4th Edition, 2023, Springer .

3. Kumar, D. & Turner, M., **Clinical Perfusion Practice: A Physiological Approach*** – 1st Edition, 2020, Cambridge Scholars Publishing.

APPLIED PERFUSION SCIENCE

1. Blood Cell Trauma and Hematological Complications

- Mechanical forces during CPB: shear stress, turbulence, cavitation
- Effects of fluid dynamics on red cells, platelets, and leukocytes
- Clinical consequences: hemolysis, thrombocytopenia, hemoglobinuria
- Complications of blood transfusion: immunologic, infectious, metabolic

2. Anticoagulation Strategies in Bypass

- Heparin pharmacology and administration during CPB
- Monitoring techniques: ACT, heparin concentration assays
- Heparin reversal with protamine: dosing, reactions, complications
- Heparin-free bypass: indications, techniques (bivalirudin, regional citrate)
- Platelet aggregation, dysfunction and CPB-induced thrombocytopenia
- Coagulopathies during CPB: dilutional, consumptive, fibrinolysis
- Management: antifibrinolytics, platelet transfusion, TEG/ROTEM-guided therapy

3. Inflammatory and Organ System Responses to CPB

- Systemic inflammatory response syndrome (SIRS) during CPB.
- Immunological, neuroendocrine, renal, metabolic, splanchnic, pulmonary, and electrolyte responses.
- Strategies to mitigate response: coated circuits, ultrafiltration, pharmacologic agents.

4. Blood Conservation Techniques

- Intraoperative blood salvage and auto-transfusion.
- Hemofiltration and dialysis during CPB: conventional, modified ultrafiltration (MUF), ZBUF.
- Reverse autologous priming (RAP) and other circuit miniaturization methods.
- Optimization of hemodilution and transfusion thresholds.

5. Microemboli and Filtration Technologies

- Microemboli: sources (gaseous and particulate), effects on cerebral and systemic perfusion
- Arterial line filters: types, pore sizes, function
- Micro-pore filtration during bypass: depth vs screen filters, inline filtration strategies
- Circuit design modifications to reduce embolic load

RECOMMENDED REFERENCE BOOKS

1. Gravlee, G.P., Davis, R.F., Stammers, A.H., **Cardiopulmonary Bypass: Principles and Practice*** – 4th Edition, 2021, Lippincott Williams & Wilkins.

2. Kumar, D., & Turner, M., *Clinical Perfusion Practice: A Physiological Approach** – 1st Edition, 2020, Cambridge Scholars Publishing.
3. Mackay, J., & Hill, J., *Perfusion for Congenital Heart Surgery: Notes on Cardiopulmonary Bypass for a Complex Patient Population* – 2nd Edition, 2022, Wiley-Blackwell
4. Mehta, Y., & Trehan, N., *Manual of Clinical Perfusion Science* – 1st Edition, 2019, Jaypee Brothers Medical Publishers.

ADVANCED PERFUSION SCIENCE

I. Mechanical Circulatory Support & Counterpulsation

- Principles of Intra-Aortic Balloon Pump (IABP)
- Mechanical assist devices: extracorporeal & intracorporeal
- Durable VADs: HeartMate II/III, HeartWare, Thoratec
- Bridge-to-transplantation and destination therapy
- INTERMACS classification
- Total Artificial Heart: design, indications, clinical outcomes
- Post-implantation care and complications.

II. Perfusion Techniques for Pediatric Cardiac Surgery

- Neonatal perfusion strategies
- Circuit miniaturization and prime techniques
- Hypothermia and cerebral protection
- Pediatric myocardial protection
- Hemofiltration and ultrafiltration in infants

III. ECMO: Extracorporeal Life Support

- VV and VA ECMO: physiology and indications
- Cannulation techniques and circuit components
- Anticoagulation strategies and monitoring
- Weaning, ECPR protocols, circuit troubleshooting
- ECMO in transport and retrieval
- ICU, nutrition, nursing during ECMO

IV. Minimally Invasive & Robotic Cardiac Surgery

- Principles and perfusion modifications in MICS
- Femoral cannulation, vacuum-assisted venous return
- Endo-aortic balloon occlusion vs transthoracic clamp
- Port-access surgery: techniques, limitations, patient selection
- Perfusion management during robotic procedures
- Challenges in de-airing and myocardial protection

V. Transplantation & Organ Preservation

- Heart, lung, and heart-lung transplantation

- Donor selection, graft harvest, preservation
- Perfusionist's role in liver and renal transplantation
- Organ preservation solutions: Custodiol, Perfadex Plus, TransMedics OCS
- Immunosuppression, rejection surveillance
- Homografts, bioprosthetic and mechanical valves
- Composite/trifurcated/valved grafts

VI . Specialized Perfusion Techniques

- Arch and aortic surgery: circulatory arrest, cerebral protection
- Regional organ perfusion (liver, brain, tumor settings)
- Hybrid/perfusion during interventional cardiology or off-site surgeries

VII. CPB Safety, Special Conditions & Innovations

- Complication identification and safety protocols in CPB
- Special patient conditions: cold agglutination, malignant hyperthermia, sickle cell disease, G6PD deficiency, HIT, methemoglobinemia, pregnancy, Jehovah's Witness protocols
- Recent advances: mini circuits, coatings, AI integration, novel perfusion modalities., Experimental perfusion research and future directions.

VIII. Recent Advances in Perfusion Technology

- Miniaturized circuits, heparin-bonded tubing, Biocompatible coatings (Phosphorylcholine, Carmeda)
- Artificial intelligence in pump control & ECMO decision-making
- Remote perfusion monitoring systems & Perfusion data integration with EMRs

IX. Experimental & Future Perfusion

- Ex vivo organ perfusion and normothermic preservation
- Xenotransplantation-related perfusion concepts
- Perfusion in bioprinting and cardiac regenerative therapies
- Perfusion strategies for wearable/implantable devices
- Clinical trials in next-gen oxygenators and pumps

RECOMMENDED REFERENCES BOOKS

1. Kapoor PM. , **Cardiac Anesthesia & Perfusion Manual** , Jaypee Brothers, 2020
2. AmSECT Standards and Guidelines for Perfusion Practice , 2024 Edition
3. Murkin JM, et al. , **Neurological Monitoring in Cardiac Surgery** , Wiley-Blackwell, 2019
4. Recent Journals: , ASAIO Journal, JECT (Journal of ExtraCorporeal Technology) , Perfusion (SAGE), Annals of Cardiothoracic Surgery.

NOTE: CANDIDATE IS NOT RESTRICTED TO THE REFERENCES AND TEXTBOOKS MENTIONED IN THE SYLLABUS

Core Calculations Required for Perfusionists

- 1. Hematocrit Adjustment (PCV on CPB) :** Calculate required blood or plasma to reach target hematocrit during CPB.
- 2. Body Surface Area (BSA) Calculation :** BSA, Lean body mass ,Used to determine cardiac index, flow rates, drug dosing.
- 3. BMI :** Guides metabolic status and indexed perfusion requirements.
- 4. Arterial Oxygen Content (CaO₂), Oxygen Delivery (DO₂).**
- 5. Oxygen Consumption (VO₂), Oxygen Extraction Ratio (O₂ER).**
- 6. Systemic Vascular Resistance (SVR) & Pulmonary Vascular Resistance (PVR).**
- 7. Oncotic Pressure & Plasma Volume Replacement**
- 8. Electrolyte Correction Calculations.**
- 9. Acid-Base Balance Interpretation.**
- 10. Arterial Blood Gas (ABG) Analysis & Priming Volume Calculations.**
- 11. Cardioplegia Delivery Volumes and Ratios.**

Core Practical Skills / Simulations

- 1. Setup of a full dummy CPB circuit with proper priming and de-airing.**
- 2. Simulated perfusion emergencies : (if available /wet lab)**
Oxygenator change, Reservoir level drop, Venous air lock, Arterial air detection, Runaway pump head, Heat exchanger water breach.
- 3. Identification and management of perfusion components:** Cannulae, oxygenators, pumps, heat exchangers
- 4. ACT testing and result interpretation**
- 5. Drug identification and perfusion pharmacology basics**
- 6. Monitoring of hemodynamics, ABG, electrolytes during bypass**
- 7. Calculation and adjustment of blood products (PRBC, FFP, Platelets)**
- 8. Management of perfusion-related coagulation issues**
- 9. Measurement of ultrafiltration volumes and fluid balance**
- 10. Safe operation of all perfusion-related devices (e.g., IABP, ECMO, centrifugal pumps)**

BEST OF LUCK

WARM GREETINGS FROM BCP-I FAMILY!

WISHING YOU ALL THE BEST FOR YOUR EXAMS AND A BRIGHT FUTURE AHEAD!