

**Jawaharlal Institute of Postgraduate Medical
Education & Research
(JIPMER)
Puducherry**



BSc Perfusion Technology

CURRICULUM

2021

This curriculum was approved at the 16th meeting of the Standing Academic Committee held on September 21, 2021, and will be applicable for students joining BSc (Allied Health Sciences) – Perfusion Technology from the academic year 2021-22. The curriculum document was prepared based on the model curricula for allied health sciences courses issued by the Ministry of Health and Family Welfare, Government of India.

TABLE OF CONTENTS

Sl. No.	TITLE	Page No.
1	About JIPMER and Department of Cardio-thoracic and Vascular surgery (CTVS)	3
2	Course details	4
3	Syllabus	9
4	Course and Examination regulations	42
5	Model question papers	46

About JIPMER

Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry (JIPMER) under Government of India since the year 1956, is one of the leading Medical Institutions of India. Spread over a sprawling 195-acre campus in an urban locale of Puducherry (formerly Pondicherry), JIPMER is 170 kms by road from Chennai.

JIPMER has been declared as an “Institution of National Importance” by an Act of Parliament, JIPMER, Puducherry, Act, 2008. A copy of the Act was Gazette notified on 14-7-2008 to enforce this Act. Prior to this, the Institute was functioning under the administrative control of Directorate General of Health Services, Ministry of Health and Family Welfare, New Delhi. The Institution is now empowered to award Medical Degrees under the clauses 23 & 24 of the said Act. Such Degrees shall be deemed to be included in the schedules to the respective Acts governing Medical Council of India/National Medical Commission, Indian Nursing Council, and Dental Council of India, entitling the holders to the same privileges as those attached to the equivalent awards from the recognized Universities of India.

JIPMER imparts Undergraduate (UG), Postgraduate (PG) and Super Specialty Medical Training through a large hospital complex (JIPMER Hospital) and a Nursing College. Some of the courses offered are MBBS, BSc, MSc, MD, MS, DM, and MCh courses. Full-time Ph.D. programs are available in several disciplines.

About the Department of CTVS

The department has been serving with wide spectrum of cases with cardiac, thoracic and vascular disorders requiring elective or emergency surgery from neonates to geriatric population and also chest trauma and vascular trauma. It also owns the credit of managing more complex and challenging cases including ECMO. Some of the highlights include creating a world surgical record of successful non-stop 24 hour marathon aortic operation in the year 2011. The first successful ECMO was achieved in the year 2016 to save a 2 month old infant of 1.75 kg following open heart surgery for complex birth malformations of the heart. An all India conference (Pertecon 2014) for perfusion technology was conducted in the year 2014.

Postdoctoral course – MCh in the field of Cardiothoracic & Vascular Surgery was started in the year 1992 and currently 3 seats are being filled up every year for this course. The department has also served to conduct DNB examination for Cardiothoracic Surgery. Two of the MCh Students from this department won the gold medal in DNB examination for cardiothoracic surgery. In the year 2010, BSc (Perfusion Technology) – a 4 year course was started and currently 5 seats per year are allotted for this course.

COURSE DETAILS

Nomenclature: BSc (Allied Health Sciences) – Perfusion Technology

Introduction

‘Perfusion Technology’ – is the subject of health science which deals with extracorporeal circulation – i.e. the support of circulation maintained through cardiopulmonary bypass (CPB) using external devices such as heart lung machine, ventricular assist devices, ECMO(extracorporeal membrane oxygenation), IABP (intra-aortic balloon pump), etc. It also includes operational knowledge on other devices related to circulatory support such as heater cooler machine to regulate the core temperature of the body by altering the temperature of circulation within a short period, blood cell saver machine which helps for conserving the shed blood cells for reuse after processing, leukocyte filter which reduces the white blood cells to mitigate inflammatory reactions, which supports the function, blood gas machine, etc.

Learning Objectives of the course

- The primary aim of BSc (Perfusion Technology) is to prepare the student professionally competent to work as a qualified ‘perfusionist’ with adequate clinical experience and academic knowledge in the subject to work as a part of the cardiothoracic surgical team and to involve in other specialty areas for non-cardiac conditions requiring circulatory support devices.
- The curriculum is designed to ascend stepwise starting from acquiring the theoretical knowledge of fundamental basic health sciences in the first year and their application in the second year to operational clinical training during the third year to handle the various circulatory assist devices such as heart lung machine, circulatory heater cooler machine, ECMO, IABP, blood cell saver, etc.
- The compulsory internship during the fourth year of training makes the completed trainees to evolve as more experienced independent professionals with augmented confidence. This internship period can be considered as the work experience during recruitment

Expectation from the future graduate

- Should be able to work independently with sound knowledge as a qualified ‘perfusionist’ in the team of members involved in the management of open-heart surgical procedures both in the operation theatre and in the intensive care units. Hence after completing the course, a perfusionist should be able to:
- To understand the basic pathophysiology of different kinds of cardiovascular and thoracic diseases
- To monitor the patient's blood flow and other vital signs during open heart surgery and gain knowledge on the drugs, intravenous fluids and blood products handled in day-to-day practice.
- To conduct cardiopulmonary bypass using a heart-lung machine and other ancillary equipment such as heater-cooler to regulate the core temperature of the body, cell saver to conserve shed blood.

- To provide lifesaving support also for patients requiring extra corporeal circulation in emergency resuscitation.
- To operate other life support equipment such as intra-aortic balloon pumps, cell saver machines.
- To update their capacity in future to handle other equipment of advanced evolving technology such as ventricular assist devices and artificial heart.

Job profile

The job of a perfusionist is to work as a team member most of the time in the Department of Cardiothoracic Surgery for routinely conducting open heart surgical procedures in the operation theatres. Perfusionists also can be trained further to assist in the maintenance of advanced circulatory assist devices such as ventricular assist devices, artificial hearts, etc.

Perfusionists also have role in supporting other specialities for managing the critical patients and also for blood conservation by virtue of their capacity to handle ECMO, IABP, blood cell saver, circulation-heater cooler machine, blood gas machine, etc. Hence, they also may be involved in non-cardiac areas such as intensive care units or operation theatres of other specialties for eg. Instituting ECMO for ARDS patients in critical care units, establishing HIPEC (Hyperthermic Intraperitoneal Chemotherapy) in onco-surgical procedures, isolated limb perfusion for cancer chemotherapy of malignant melanoma, etc.

BSc (Allied Health Sciences) – Perfusion Technology is a four-year course with three-year academic program divided into three phases of one year each and one year compulsory internship period.

First phase: one year

In addition to the subjects of Foundation course, Anatomy, and Physiology, students will learn the basic concepts in areas such as Biochemistry, Pathology, and introductory concepts of perfusion technology.

Second phase: one year

In the Second phase, the students will learn the applied anatomy and physiology pertaining to the cardiovascular system. In addition, they learn the Pathology and Pharmacology relevant to the Perfusion technology along with its fundamental aspects.

Third phase: one year

In the Third phase, the students will learn to handle the various circulatory assist devices such as heart lung machine, circulatory heater cooler machine, ECMO, IABP, blood cell saver, etc.

Internship: one year

Internship of one year is compulsory. The interns will be given hands-on training to handle the various circulatory assist devices such as heart lung machine, circulatory heater cooler machine, ECMO, IABP, blood cell saver, etc

Eligibility for the course:

- The Applicant should be an **Indian National**.
- He/she should have completed **17 years** at the time of application cut-off date.
- There is **no upper age limit**.

The applicants should have passed the qualifying examinations in the manner mentioned below:

- The Higher / Senior Secondary Examination or the Indian School Certificate Examination which is equivalent to 10+2 Higher/Senior Secondary Examination after a period of 12 years study, the last two years of such study comprising Physics, Chemistry, Biology/ Botany & Zoology (which shall include practical tests in these subjects) and with English as a subject.
- The applicant must have passed in the subjects of Physics, Chemistry, Biology/Botany & Zoology and English individually and must have obtained a minimum of 50% marks taken together in Physics, Chemistry, Biology/Botany & Zoology at the qualifying examination
- Candidates belonging to the Scheduled Castes/Scheduled Tribe or Other Backward Classes must have obtained a minimum of 40% marks in the subjects of Physics, Chemistry, Biology / Botany & Zoology taken together in the qualifying examination.
- For PwD candidates in general and EWS categories, the minimum marks in Physics, Chemistry, Biology/ Botany & Zoology taken together in the qualifying examination is 45%.

Candidates intake per year:

Five candidates will be admitted to the course every year. There is no provision for sponsored / nominated candidates.

Duration of the course

4 years (48 months) duration including 3 years of classes and one year of compulsory internship.

Medium of instruction:

English

Vacation:

Students will be eligible for 4 weeks of vacation in summer and 2 weeks in winter.

Subject details:

Phase	Paper	Title of the paper
I	I	Foundation course (T & P)
	II	Anatomy and Physiology (T & P)
	III	Pathology and Microbiology (T)
	IV	Introduction to Perfusion Technology(T & P)
II	I	Applied Anatomy & Applied Physiology (T & P)
	II	Applied pathology & Applied Pharmacology (T & P)
	III	Biomedical Engineering & Fundamental Perfusion Technology(T & P)
III	I	Pathophysiology of Cardiopulmonary bypass I & II (T & P)
	II	Clinical application of Cardiopulmonary bypass & Paediatric perfusion (T & P)
	III	Advanced perfusion & Special perfusion(T & P)
IV	Internship period	

T- Theory, P- Practical

Teaching hours:

Phase	Subject	Theory	Practical	Others
I	Foundation course	80	40	
	Anatomy	60	180	
	Physiology	60	180	
	Pathology	40		
	Microbiology	40		
	Introduction to Perfusion Technology	60	280	
	Self-study/Library			60
Total				1080
II	Applied Anatomy & Applied physiology	60	280	
	Applied pathology & Applied Pharmacology	60	280	
	Biomedical Engineering & Fundamental Perfusion Technology	60	280	
	Self-study/Library			60
Total				1080
III	Pathophysiology of Cardiopulmonary bypass I & II	60	280	
	Clinical application of Cardiopulmonary bypass & Paediatric perfusion	60	280	
	Advanced perfusion & Special perfusion	60	280	
	Self-study/Library			60
Total				1080
IV	Internship			

SYLLABUS

Phase I

Paper I: Foundation course

Theory:

Introduction to National Healthcare System

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

1. Introduction to healthcare delivery system
 - a. Healthcare delivery system in India at primary, secondary and tertiary care
 - b. Community participation in healthcare delivery system
 - c. Health system in developed countries.
 - d. Private Sector
 - e. National Health Mission
 - f. National Health Policy
 - g. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements, and constraints in various National Health Programme.
3. Introduction to AYUSH system of medicine
 - a. Introduction to Ayurveda.
 - b. Yoga and Naturopathy
 - c. Unani
 - d. Siddha
 - e. Homeopathy
 - f. Need for integration of various system of medicine
4. Health scenario of India- past, present, and future
5. Demography & Vital Statistics-
 - a. Demography – its concept
 - b. Vital events of life & its impact on demography
 - c. Significance and recording of vital statistics
 - d. Census & its impact on health policy
6. Epidemiology
 - a. Principles of Epidemiology
 - b. Natural History of disease
 - c. Methods of Epidemiological studies

d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defence immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Medical terminologies and record keeping

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests.²⁵ Topics to be covered under the subject are as follows:

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

Basic computers and information science

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
2. Input output devices: Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).
3. Processor and memory: The Central Processing Unit (CPU), main memory.
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.

5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing, and maximizing, etc.).
6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
9. Introduction of Operating System: introduction, operating system concepts, types of operating system.
10. Computer networks: introduction, types of networks (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
12. Application of Computers in clinical settings.

Medical law and ethics

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.²⁶

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analysing, and attempting to resolve the ethical problems that arise in practice".²⁶ Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to focus on are as follows:

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality
4. Malpractice and negligence - Rational and irrational drug therapy
5. Autonomy and informed consent - Right of patients

6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
9. Professional Indemnity insurance policy
10. Development of standardized protocol to avoid near miss or sentinel events
11. Obtaining an informed consent.

Communication and soft skills

Major topics to be covered under Communication course –

1. Basic Language Skills: Grammar and Usage.
2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.
3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

Introduction to Quality and patient safety

1. Quality assurance and management - The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.
 - a. Concepts of Quality of Care
 - b. Quality Improvement Approaches
 - c. Standards and Norms
 - d. Quality Improvement Tools
 - e. Introduction to NABH guidelines
2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency

response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:

- a. Vital signs and primary assessment
- b. Basic emergency care – first aid and triage
- c. Ventilations including use of bag-valve-masks (BVMs)
- d. Choking, rescue breathing methods
- e. One- and Two-rescuer CPR
- f. Using an AED (Automated external defibrillator).
- g. Managing an emergency including moving a patient

At the end of this topic, focus should be to teach the students to perform the manoeuvres in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above-mentioned modalities.

3. Bio medical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment, and the general public. Topics to be covered under the subject are as follows:

- a. Definition of Biomedical Waste
- b. Waste minimization
- c. BMW – Segregation, collection, transportation, treatment, and disposal (including colour coding)
- d. Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
- e. BMW Management & methods of disinfection
- f. Modern technology for handling BMW
- g. Use of Personal protective equipment (PPE)
- h. Monitoring & controlling of cross infection (Protective devices)

4. Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –

- a. Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],
- b. Prevention & control of common healthcare associated infections,
- c. Components of an effective infection control program, and

d. Guidelines (NABH and JCI) for Hospital Infection Control

5. Antibiotic Resistance-

- a. History of Antibiotics
- b. How Resistance Happens and Spreads
- c. Types of resistance- Intrinsic, Acquired, Passive
- d. Trends in Drug Resistance
- e. Actions to Fight Resistance
- f. Bacterial persistence
- g. Antibiotic sensitivity
- h. Consequences of antibiotic resistance
- i. Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals

6. Disaster preparedness and management- The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-

- a. Fundamentals of emergency management,
- b. Psychological impact management,
- c. Resource management,
- d. Preparedness and risk reduction,
- e. Key response functions (including public health, logistics and governance, recovery, rehabilitation, and reconstruction), information management, incident command and institutional mechanisms.

Professionalism and values

The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant professionalism in terms of healthcare system is and how it affects the overall patient environment.

1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality
2. Personal values- ethical or moral values
3. Attitude and behaviour- professional behaviour, treating people equally
4. Code of conduct, professional accountability and responsibility, misconduct
5. Differences between professions and importance of team efforts
6. Cultural issues in the healthcare environment

Research Methodology and Biostatistics

The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings.

1. Introduction to research methods
2. Identifying research problem
3. Ethical issues in research
4. Research design
5. Basic Concepts of Biostatistics
6. Types of Data
7. Research tools and Data collection methods
8. Sampling methods
9. Developing a research proposal

Principles of Management

The course is intended to provide a knowledge about the basic principles of Management.

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

Community orientation and clinical visit

The objective of this section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the undergraduate program and across their career. Innovative teaching methods should be used to ensure the attention of a student and make them more receptive such as group activities, interactive fora, role plays, and clinical bed-side demonstrations.

1. The community orientation and clinical visit will include visit to the entire chain of healthcare delivery system -Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries, and clinics.
2. The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front-line health workers.
3. Clinical visit to their respective professional department within the hospital.

Practical:

Fundamentals of computers

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel
2. To install different software.
3. Data entry efficiency

Paper II: Anatomy and Physiology

Gross anatomy and Histology

Theory:

General Anatomy:

Introduction – Anatomical terms, position, movements; epithelium – classification, structure & examples; Tissues – classification and structure; skin – structure, thick and thin skin; cartilage – types, structure, hyaline, elastic, and white fibrocartilage; bones – classification, structure, growth; muscles - classification & structure; glands - classification & structure.

Musculoskeletal system:

Axial and appendicular skeleton – muscle groups and regions muscles with action.

Cardiovascular and lymphatic system:

Structure of pericardium, heart & major blood vessels – arteries, veins, and lymphatic system – classification and structure of lymphoid organs – thymus, spleen, lymph node, tonsil, and major lymphatic vessels.

Respiratory system:

Parts of respiratory system, structure of external nose, paranasal air sinuses, nasal cavity, nasopharynx, larynx, trachea, pleura, lungs & diaphragm.

Gastrointestinal system:

Parts of gastrointestinal system, salivary glands, oral cavity, oropharynx and laryngopharynx, esophagus, stomach, small intestine, large intestine, liver, gallbladder, extrahepatic biliary apparatus, and pancreas.

Excretory system:

Parts of excretory system – structure of kidney, ureter, urinary bladder & urethra.

Male and female reproductive systems:

Structure & parts of male reproductive system, external genitalia, testis, epididymis, vasdeferens, seminal vesicle and prostate.

Structure & parts of female reproductive system, uterus, ovary, fallopian tubes, and mammary gland

Endocrine system:

Location & structure of thyroid, parathyroid, pituitary, adrenal glands.

Special senses:

Structure of eyeball, external, middle & internal ear, and papillae of tongue.

Nervous system:

Neuron, neuroglia, classification, autonomic nervous system, meninges, parts of brain, cerebrum, cerebellum, basal nuclei, limbic system, thalamus, hypothalamus, spinal cord, circulation of cerebrospinal fluid.

Histology:**General histology:**

Microscopy – Types of microscopes, parts of microscope, cleaning, and maintenance of microscope.

Microscopic features of

1. Cartilages
 - 1.1 Hyaline,
 - 1.2 Elastic
 - 1.3 White fibro cartilages
2. Bones
 - 2.1 Longitudinal section of compact bone
 - 2.2 Cross section of compact bone
3. Muscles
 - 3.1 Skeletal muscle
 - 3.2 Cardiac muscle
4. Glands
 - 4.1 Serous gland
 - 4.2 Mucous gland
 - 4.3 Mixed gland
5. Blood vessels
 - 5.1 Medium sized artery
 - 5.2 Large sized artery
 - 5.3 Medium sized vein
 - 5.4 Large sized vein
6. Nervous tissue
 - 6.1 Peripheral nerve H & E stain
 - 6.2 Peripheral nerve Osmic acid stain
 - 6.3 Dorsal root (spinal) ganglia
 - 6.4 Autonomic ganglia
7. Lymphoid organs
 - 7.1 Thymus
 - 7.2 Lymph node
 - 7.3 Spleen
 - 7.4 Tonsil
8. Skin
 - 8.1 Thick skin
 - 8.2 Thin skin

Practical: Anatomy (Gross anatomy and Histology)

1. Demonstration of bones
2. Demonstration of various parts of body
3. Demonstration of parts of digestive system
4. Demonstration of parts of respiratory system
5. Demonstration of parts of reproductive system
6. Demonstration of parts of excretory system
7. Demonstration of various parts of circulatory system
8. Demonstration of various parts of nervous system
9. General histology slides

Textbooks Recommended (Latest edition):**General Anatomy:**

1. Handbook of General Anatomy – B.D. Chaurasia - CBS Publishers

Systemic Anatomy:

1. Textbook of Anatomy – Vishram Singh – Elsevier
2. B.D. Chaurasia's Human Anatomy – CBS Publishers
3. Manipal Manual of Anatomy for Allied Health Science Courses

Histology:

1. Textbook of Human Histology: With Color Atlas 3D Illustrations – Dr. Yogesh Sontakke
2. Textbook of Histology - A Practical guide – Dr. J. P Gunasegaran
3. Di Fiore's Atlas of Histology – Eroschenko – Lippincott Williams & Wilkins

Reference textbook:

Gray's Anatomy: The Anatomical Basis of Clinical Practice – Susan Standring – Elsevier

Physiology**Theory:****1. General Physiology**

- a. Principle of homeostasis
- b. Cell membrane, cell organelles, intercellular junctions
- c. Transport across cell membrane
- d. Body fluids: Classification of body fluid compartments, ionic composition, measurement
- e. Resting membrane potential

2. Blood

- a. Composition of blood
- b. Plasma proteins: classification and functions
- c. RBC: development, morphology, counts, functions, and dysfunctions
- d. Hemoglobin: types, structure, synthesis, function, degradation, anemia
- e. WBC: development, classification, morphology, counts, functions, and dysfunctions
- f. Immunity: definition, classification, Innate, Cellular and Humoral Immunity
- g. Platelets: morphology, counts, development, functions, and dysfunctions
- h. Blood coagulation: clotting factors, mechanism, dysfunctions
- i. Anticoagulants
- j. Blood grouping: classification, cross matching, blood transfusion, Rh factor, and incompatibility

3. Nerve

- a. Structure, function, classification of neurons
- b. Neuronal action potential: ionic basis and properties
- c. Conduction of nerve impulses
- d. Nerve Injuries
- e. Neuromuscular junction: structure, mechanism of transmission & applied aspects

4. Muscle

- a. Structure of skeletal muscle & sarcomere system
- b. Mechanism of contraction and relaxation of skeletal muscle
- c. Isotonic and isometric contraction
- d. Properties of skeletal muscle
- e. Smooth muscle: structure, properties, and mechanism of contraction
- f. Differences between skeletal, smooth, and cardiac muscles

5. Autonomic nervous system

- a. Divisions and functions

6. Gastrointestinal (GI) system

- a. Functional anatomy of GIT
- b. Gastrointestinal hormones
- c. Principles & Functions of GI secretions, applied aspects
- d. Movements of GIT, applied aspects

7. Endocrine system

Hormones, actions, and dysfunctions of various endocrine glands:

- a. Hypothalamus
- b. Pituitary
- c. Thyroid
- d. Parathyroid and hormones involved in calcium homeostasis
- e. Adrenal gland
- f. Endocrine pancreas

8. Reproductive System

- a. Male and female gametogenesis

- b. Structure and function of male reproductive system
- c. Structure of female reproductive system, menstrual cycle, pregnancy, parturition, lactation
- d. Contraceptives

9. Kidney

- a. Structure & function of kidney, structure of nephron, composition of urine
- b. Glomerular filtration rate: definition, values, regulation and measurement
- c. Mechanism of urine formation: tubular functions, concentration of urine, acidification of urine
- d. Micturition reflex
- e. Diuretics
- f. Dialysis

10. Cardiovascular system

- a. Functional anatomy of heart
- b. Circulatory system: arterial, venous, capillary circulation
- c. Structure and properties of cardiac muscle
- d. Electrophysiology of heart and conduction of impulse
- e. ECG: waveforms and physiological basis
- f. Cardiac cycle, heart sounds, Jugular venous pulse
- g. Stroke volume, heart rate, cardiac output – definition, normal values and their regulation
- h. Blood pressure and regulation
- i. Coronary circulation
- j. Lymphatic circulation
- k. Applied aspects: shock, hypertension, hypotension, tachycardia, bradycardia, heart failure

11. Respiratory system

- a. Functional anatomy of respiratory system
- b. Mechanics of breathing, lung volumes and capacities, compliance, surfactant
- c. Alveolar ventilation, dead space, pulmonary circulation, ventilation-perfusion ratio
- d. Diffusion and gas exchange
- e. Transport of oxygen and carbon dioxide
- f. Brief account of respiratory regulation
- g. Acclimatization, definition & types of hypoxia, oxygen therapy, cyanosis, asphyxia.
- h. Methods of artificial respiration

12. Central nervous system

- a. Parts and functions of brain and spinal cord
- b. Sensory system: receptors and ascending pathways
- c. Motor system: motor neurons, motor units, muscle spindle, stretch reflex, and descending tracts with emphasis on corticospinal tract
- d. Cerebellum- functional anatomy, functions, and dysfunctions

- e. Basal ganglia- functional anatomy, functions, and dysfunctions
- f. Functions of hypothalamus
- g. Functions of Thalamus
- h. Types of sleep and EEG
- i. Cerebrospinal fluid
- j. Higher functions: types of memory, centers of speech, types of aphasia in brief, Cerebral cortex-lobes and functions
- k. Blood-brain barrier

13. Special senses

- a. Vision: Components of visual apparatus, visual acuity, color vision, accommodation, errors of refraction, visual pathway, pupillary reflexes
- b. Hearing: External, middle ear, inner ear and their functions, auditory pathway, hearing tests.
- c. Taste – receptors and pathway
- d. smell: receptors and pathway

14. Integrative Physiology

- a. Structure and functions of skin
- b. Regulation of temperature

Practical: Physiology

1. Hematology

- a. Methods of collection of blood
- b. Microscopy
- c. Haemocytometry
- d. Total RBC count
- e. Estimation of haemoglobin
- f. Calculation of blood indices
- g. Demonstration of osmotic fragility of red blood cells
- h. Determination of ESR
- i. Total leucocyte count
- j. Absolute eosinophil count
- k. Peripheral blood smear
- l. Differential leukocyte count
- m. Arneht count
- n. Determination of blood group
- o. Bleeding time, Clotting time
- p. Demonstration of reticulocyte count
- q. Demonstration of platelet count
- r. Demonstration of PCV

2. Clinical

- a. General physical examination
- b. Clinical examination of Radial pulse
- c. Determination of blood pressure
- d. Recording of Electrocardiogram
- e. Examination of cardiovascular system
- f. Examination of respiratory system
- g. Demonstration of spirometry
- h. Determination of vital capacity and effect of posture of vital capacity
- i. Examination of sensory system
- j. Examination of motor system
- k. Visual acuity
- l. Color vision
- m. Pupillary reflexes
- n. Perimetry
- o. Tests of hearing
- p. Mosso's ergography

Textbooks recommended: (Latest edition)

1. Textbook of Medical Physiology by G.K. Pal (Theory)
2. Textbook of Practical Physiology by G.K. Pal & Pravati Pal (Practical)

Teaching learning methodology:

The course content in Physiology will be covered by:

1. Interactive Lectures
2. Group Discussions
3. Practical classes & demonstrations
4. Seminars
5. Assignments

Paper III: Pathology and Microbiology

Pathology

The Pathology syllabus introduces the principles of **Pathology** with emphasis on applied aspects of Pathology particularly in the following areas:

1. Collection and transport of specimens for routine pathological investigations
2. Common routine pathology tests
3. General concepts of Pathology
4. Laboratory diagnosis of common pathological conditions
5. Systemic Pathology
6. Applied Surgical Pathology, cytopathology, hematopathology, renal pathology and neuropathology

Theory:

1. Adaptations, cell injury and repair

- a. Hyperplasia,
- b. hypertrophy,
- c. atrophy,
- d. metaplasia,
- e. Necrosis and
- f. Apoptosis

2. Acute and chronic inflammation

- a. Cardinal signs of inflammation
- b. Outcomes of acute inflammation
- c. Chronic inflammation
- d. Granulomatous inflammation
- e. Acute phase proteins

3. Tissue repair, regeneration, and hemodynamic disorders

- a. Cutaneous wound healing
- b. Pathological aspects of repair
- c. Hyperaemia and congestion
- d. Thrombosis and Virchow triad
- e. Embolism, infarction, and shock

4. Disorders of immune system

- a. Types of hypersensitivity reactions
- b. Autoimmune diseases

5. Neoplasia

- a. Definition of neoplasia.

- b. Differences between benign and malignant tumours
- c. Metastasis
- d. Carcinogenesis – causes

6. Applied general pathology related to transfusion medicine

- a. ABO blood group & Rh system (terminologies)
- b. Principles of blood grouping and cross matching
- c. Shelf life of stored blood
- d. Anticoagulants used for storing blood and temperature for storage

7.RBC, WBC, and bleeding disorders

- a. Anaemia – definition and classification
- b. Iron deficiency anaemia and haemolytic anaemia
- c. Leukocytosis and leukaemia
- d. Causes of splenomegaly
- e. Thrombocytopenia and coagulation disorders
- f. Phlebotomy, haemoglobin estimation, peripheral smear examination, bleeding time, PT and APTT

8. Disorders of GI tract, liver, biliary tract, and pancreas

- a. Causes of peptic ulcer, carcinoma stomach, intestinal obstruction, acute appendicitis, and colonic carcinoma
- b. Jaundice – classification based on pathophysiology
- c. Cirrhosis – definition and causes
- d. Hepatitis – types and mode of transmission
- e. Portal hypertension and hepatic failure

9. Blood vessels, heart, and lung diseases

- a. Risk factors for atherosclerosis and their classification
- b. Hypertension – definition and causes
- c. Varicose veins, thrombophlebitis and phlebothrombosis
- d. Congenital heart disease and heart failure
- e. Myocardial infarction and cor-pulmonale
- f. Rheumatic heart disease
- g. Chronic obstructive airway disease
- h. Asthma, pneumonia, and lung carcinoma

10.The kidney and lower urinary tract, male and female genital tract

- a. Acute and chronic renal failure
- b. Nephrotic and nephritis syndrome
- c. Acute tubular necrosis and urolithiasis
- d. Carcinoma penis, testicular tumours, and prostatic hyperplasia
- e. Endometriosis, adenomyosis and leiomyoma

11. Endocrine and nervous system

- a. Diagnostic criteria, types, and complications of diabetic mellitus
- b. Intracerebral, subarachnoid, and subdural haemorrhage
- c. Meningitis and encephalitis
- d. Epilepsy and CNS tumours

12. Applied Surgical Pathology & Cytopathology, renal pathology, and neuropathology

- a. Histopathology techniques
- b. Fine needle aspiration cytology and imprint cytology
- c. Basic terminologies of surgical specimens
- d. Urine analysis and renal biopsy
- e. CSF cytology, nerve and muscle biopsy, squash cytology

Textbooks recommended (latest edition):

1. Illustrated Pathology – McFarlen
2. Essentials of Rubin's Pathology
3. Basic Pathology by Robbins
4. General and systemic Pathology – Underwood and Cross

Teaching and Learning methodology

Mostly will be didactic lectures with tutorials.

Microbiology

The Microbiology syllabus introduces the principles of **Microbiology** with emphasis on applied aspects of Microbiology of infectious diseases particularly in the following areas

1. Universal and Standard precaution.
2. Collection and transport of specimens for routine microbiological investigations.
3. Common routine serological tests
4. General concept of infection
5. Common Bacteriological, Viral, Fungal, Parasitic infection and Laboratory diagnosis
6. Nosocomial infection
7. Biomedical waste management
8. Vaccine

Theory:**Introduction and Morphology**

Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria.

Growth and Nutrition

Nutrition, Culture media, Types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test.

Sterilisation and Disinfection

Principles and use of equipment of sterilization namely Hot Air oven, Autoclave and serum inspissator. Pasteurization, Anti septic and disinfectants.

Immunology

Immunity, Types of Immunity, Vaccines, Types of Vaccine and immunization schedule. Principles and interpretation of commonly done serological tests namely Widal, VDRL, ASLO, ELISA, Rapid tests for HIV and HbsAg

Systematic Bacteriology

Morphology, diseases caused, laboratory diagnosis including specimen collection of the following bacteria (the classification, antigenic structure and pathogenicity are not to be taught) Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, C. diphtheriae, Mycobacterium tuberculosis, Clostridium spp., Bacillus spp., Shigella spp., Salmonella spp., Escherichia coli, Klebsiella spp., Proteus spp., Vibrio cholera, Pseudomonas spp. & Spirochaetes

Parasitology

Morphology, life cycle, laboratory diagnosis of following parasites E. histolytica, Plasmodium spp., Tapeworms, Intestinal nematodes, Filariasis

Mycology

Morphology, diseases caused, laboratory diagnosis of following fungi. Candida, Cryptococcus, opportunistic fungi

Virology

General properties of viruses, diseases caused, lab diagnosis and prevention of following viruses, Herpes, Hepatitis, HIV, Rabies and Poliomyelitis

Hospital Infection

Causative agents, transmission methods, investigation, prevention and control Hospital infection, Universal precaution, Standard precaution

Principles and Practice Biomedical Waste Management**Applied Microbiology**

Causative agents, Sample collection and Laboratory diagnosis

Gastrointestinal infections, Nosocomial infections, Urinary tract infections, Respiratory tract infections, Pyogenic Meningitis, Food borne infections, Vector borne infections, Blood borne infections, Aerosol borne infections.

Textbooks recommended (latest editions):

1. CP.Baveja. Textbook of Microbiology for nurses. Arya Publishing Company.
2. RLIchhpujani, Rajesh Bhatia. Essentials of Medical Microbiology. Jaypee Brothers Medical Pub (p) Ltd.
3. Seema Sood.Microbiology for Nursing Students & Nurses. Elsevier India Pvt.Ltd.
4. Satish Gupte. Short Textbook of Medical Microbiology. Jaypee Brothers Medical Pub (p) Ltd.
5. CK Jayaram Paniker, Ananthanarayan R. Textbook of Microbiology for nurses. Publisher Universities Press (India) Limited.
6. B.S.Nagoba. Clinical Microbiology. Bi Publications Pvt Ltd.
7. Clint E Carter, Burton J Bogitsh, Thomas N Oeltmann.Human Parasitology. Publisher Elsevier India Pvt.Ltd.

Paper IV: Introduction to Perfusion Technology

- History of cardio-thoracic surgery
- Introduction to various cardio-thoracic surgeries
- Basics of procedures and techniques involved in cardiac surgeries
- Evolution and advances in cardiac surgery
- Discovery of heparin
- Discovery of cardioplegia
- Discovery of heart lung machine
- History of development of oxygenators
- Evolution of concepts of hypothermia,
- Controlled cross circulation
- Inflow-occlusion
- First open-heart surgery
- Principles of open-heart operation
- Introduction to various equipment related to Cardio-thoracic and vascular surgery
- Introduction to Cardiopulmonary bypass (CPB)
- Introduction to Defibrillator and Ventilator
- Instrumentation used in cardiac surgeries
- Fundamentals of pharmacokinetics and pharmacodynamics
- Introduction to drugs related to the cardiovascular system
- Basic and advanced resuscitation procedures

Phase II

Paper I: Applied Anatomy & Applied Physiology

Applied Anatomy

1. Cardiac

- Heart chambers – Interior and exterior
- Heart valves
- Coronary arteries
- Coronary venous circulation
- Cardiac lymphatic system
- Conduction system of the heart
- Pericardium
- Mediastinum

2. Thoracic

- Chest wall, ribs, intercostal spaces, sternum
- Diaphragm
- Muscles of respiration
- Trachea
- Pleura and lungs
- Bronchopulmonary segments
- Pulmonary & bronchial vasculature

3. Vascular

- Ascending aorta, Arch of aorta & Descending thoracic aorta,
- Abdominal aorta
- Renal artery, visceral arteries of abdomen subclavian artery, Common carotid artery, Axillary artery
- Brachial artery, radial artery, Ulnar artery
- Iliac artery, Femoral artery, Popliteal artery,
- Arteries of the leg, Dorsalis pedis artery
- Inferior vena cava
- Superior vena cava
- Pulmonary circulation

4. Miscellaneous

- Cerebral circulation,
- Hepato-portal – mesenteric circulation,
- Renal circulation

Applied Physiology

1. Cardiac

- Circulatory pathways of blood in fetal life and adults. Pattern of circulation.
- Changes occurring during various phases of cardiac cycle (pressure tracings and ECG)
- Cardiac output – definition, measurements, regulation, and control & cardiac index
- Heart rate, Stroke volume, cardiac work, preload, afterload, – factors controlling them.
- Coronary circulatory physiology and myocardial oxygen consumption.
- Circulatory pressures - systolic pressure, diastolic pressure, mean pressure - their significance
- Arterial pressure and its regulation
- Systemic and pulmonary vascular resistance – vasodilatory and constrictive factors.
- Total body water, blood volume, extracellular fluid & intracellular fluid.
- Oncotic pressure & hydrostatic pressure – Starling's principle.
- Basics of electrocardiogram – Definition, electrical condition, atrial activation, atrial complex, ventricular activation, ventricular complex and normal values
- Cyanosis & Hyperviscosity.

2. Respiratory

- Upper airway function and natural defense mechanism against airway aspiration during swallowing
- Respiratory epithelial function. Lung parenchyma, alveolar macrophages, and surfactant.
- Physics of ventilation – principles of elasticity compliance and airway resistance.
- Mechanism and regulation of respiration, Principles of gaseous exchange
- Partial pressure of oxygen and carbondioxide (pO_2 , pCO_2), Hypoxia, Hypercarbia
- Oxygen saturation (SaO_2 , SpO_2), oxygen content (CO_2), Oxygen saturation curve
- Lung volumes : Tidal volume, vital capacity, residual volume, respiratory minute volume, dead space volume.
- Ventilation/perfusion ratio and its effects. Physiological shunt

3. Metabolic

- Blood gas analysis - Metabolic/Respiratory acidosis, Metabolic/Respiratory alkalosis,
- Hypocalcaemia, Hypercalcemia,
- Hypokalemia, Hyperkalemia,
- Hyponatremia, Hypernatremia
- Hypomagnesemia,
- Hypothermia, Hyperthermia
- Renal function parameters

D. Blood clotting mechanism related:

- Coagulation factors, Coagulation pathways
- Platelet aggregation
- Fibrinolytic system
- Prothrombin time (PT), Activated partial thromboplastin time (APTT),
- International Normalized Ratio (INR),
- Activated Clotting Time (ACT),
- Heparin neutralization curve,
- Thromboelastogram (TEG)

Paper II: Applied Pathology & Applied Pharmacology

Applied Pathology

1. Cardiac

- Acquired cardiovascular disorders – introduction & surgical management
 - Coronary artery disease,
 - Valvular heart disease – stenosis and regurgitation
 - Cardiomyopathy, Cardiac hypertrophy, and hypertensive heart disease
 - Myocarditis, Pericarditis, Infective endocarditis
 - Cor pulmonale and pulmonary hypertension
 - Heart tumours
 - Arrhythmias and conduction disorders
 - Diseases of the aorta: Aneurysms and dissections
- Congenital cyanotic heart disease - introduction
 - Persistent truncus arteriosus (PTA)
 - Transposition of great arteries (TGA)
 - Total anomalous pulmonary venous connection (TAPVC)
 - Tetralogy of Fallot (TOF)
 - Tricuspid atresia
- Congenital heart disease with left to right shunt - introduction
 - Persistent ductus arteriosus (PDA)
 - Ventricular septal defect (VSD)
 - Atrial septal defect (ASD)
 - Ruptured sinus of aneurysm of sinus of Valsalva (RSOV)
 - Aortopulmonary window (APW)
- Other congenital heart diseases – introduction
 - Ebstein's anomaly
 - Atrioventricular septal defect – partial & complete
 - Single Ventricle
 - Hypoplastic left heart syndrome

2. Thoracic:(Brief outline with management)

- Chronic obstructive airway diseases – definition and types
- Chronic suppurative pulmonary disease and sequelae– lung abscess, bronchiectasis, empyema.
- Pulmonary congestion and edema
- Pleural effusion – causes, effects and diagnosis.
- Chest wall disorders – pectus excavatum&excarinatum, scoliosis, kyphosis
- Diaphragmatic hernia – congenital & acquired
- Pneumonia,
- ARDS (Adult respiratory distress syndrome)
- Acute lung injury

Applied Pharmacology

Indications, dose, administration and side effects of

- Heparin & Protamine
- Oral anticoagulant drugs
- Antiplatelet agents
- Fibrinolytic agents &
- Antifibrinolytic agents
- Antiarrhythmic agents
- Inotropes including Inodilators
- Digoxin
- Vasopressors & vasopressin
- Diuretics
- Vasodilators
- Calcium channel blockers,
- Antianginal drugs
- Alpha blockers
- Beta blockers
- Nitric oxide.
- Cardioplegic agents
 - Priming solutions.
 - Potassium & Sodium,
 - Magnesium & Calcium.
 - Sodium bicarbonate
- Anti-lipid agents
- Bronchodilators
- Anesthetic agents:
 - Nitrous oxide
 - Sevoflurane
 - Vecuronium
 - Morphine
 - Fentanyl
 - Thiopental

Paper III: Biomedical Engineering & Fundamental Perfusion Technology

Biomedical Engineering/ Blood transfusion/Implants in cardiac surgery

- Basics of Biomedical Engineering: (will be dealt by the Biomedical Engineers)
- Research Methodology (Department of Biostatistics)
- Haematology relevant to Perfusion – (Department of Blood Transfusion Medicine)
- Blood transfusion: a) Transfusion practices
b) Blood & blood products – indications, storage & transfusion techniques.
- Prosthetic heart valves (mechanical/ bioprosthetic)
- Homografts
- Grafts — collagen impregnated grafts, trifurcated grafts, arch vessel, composite valved grafts

Fundamental Perfusion Technology

- Clinical evaluation of patients & Investigations: Chest X-ray, ECG, CT scan, MRI, angiogram, and cardiac catheterization
- Monitoring equipment for: Hemodynamics, Coagulation status, Blood gas, Temperature, etc.
- Cardiopulmonary Resuscitation (CPR).
- Hardware requirement for open heart surgery – complete description.
 - Heart lung machine - Gas blender, monitors, pressure gauge, transducers, oxygen line, roller pumps, centrifugal pump, hand crank, control panel.
 - Consumables - Connecting circuit, oxygenators, venous reservoirs, cardioplegia delivery system, filters, suction tubes, cannulas – various types with merits and demerits.
 - Heat exchanger, temperature control module
- Other equipment:
 - ACT (activated coagulation time) machine
 - Cell saver (autotransfusion system) machine – hardware
 - Components of IABP machine.
- Miscellaneous –
 - Perfusion data recording
 - Store keeping of perfusion items.
- Sterility concept and awareness - Safe hand wash, proper use of personal protection equipment, safe wearing of gloves and gowns, sterile zone maintenance, antiseptic and disinfectant usage, sterilization of materials.

Phase III

Paper I: Pathophysiology of Cardiopulmonary bypass I&II

Pathophysiology of Cardiopulmonary bypass (CPB) - I

1. Temperature management of extracorporeal circulation and its effects (History of hypothermia concepts, types of hypothermia, deep hypothermic circulatory arrest, pathophysiology of hypothermia and warming, alpha stat and pH stat strategies, clinical benefits)
2. Hemodilution & priming solutions – strategy and effects (Historical aspects, process of hemodilution and its physiological effects . Types of priming solution and the criteria for prediction of haematocrit during CPB and its optimization to the temperature, Factors affecting hematocrit during CPB, Additions to the priming solutions)
3. Effects of transfusion of blood & blood products i. Acute transfusion reactions including acute haemolytic reactions, febrile non-hemolytic transfusion reaction (FNHTR), transfusion related acute lung injury (TRALI), allergic reaction, anaphylactic reaction, hypotensive reaction, transfusion associated circulatory overload (TACO), bacterial sepsis and other infections. ii. Delayed transfusion reactions including delayed hemolytic transfusion reaction (DHTR), delayed serologic transfusion reaction (DSTR), febrile non-hemolytic transfusion reaction (FNHTR) and Delayed allergic reaction.
4. Myocardial protection – methods and effects (Historical aspects, Cardioplegia – delivery routes, types, components, Intraoperative adjuncts to myocardial protection, Myocardial protection without cardioplegic administration – Ischemic preconditioning, intermittent fibrillation, off pump surgery)
5. Hematological effects and coagulopathy due to cardiopulmonary bypass (Hematologic factors activated by CPB, etiology of bleeding effects of CPB including both platelet related factors and non-platelet related factors)
6. Anticoagulation and neutralization during CPB (Heparin effects, heparin neutralization, protamine effects, direct thrombin inhibitors)

Pathophysiology of CPB - II

1. Immune and inflammatory responses to cardiopulmonary bypass (CPB)
2. Endocrine, metabolic and electrolyte responses to CPB
3. Embolic effects of CPB
4. Renal effects of CPB
5. Neurologic effects of CPB
6. Splanchnic visceral effects of CPB
7. Pulmonary effects of CPB

Paper II: Clinical application of Cardiopulmonary bypass & Paediatric perfusion**A. Clinical Application Cardiopulmonary bypass****1. Pre-surgical checklist and preparation for CPB:**

- Patient chart preparation for various calculations including flow rate and hemodilution, inventory availability, equipment function check, equipping for alternate arrangements in failure of routine methods.

2. Pre-CPB procedures:

- Setting up of equipment- Heart- lung machine with monitoring tools, temperature control machine, Intra-aortic balloon pump (IABP) machine and cell saver machine.
- Setting up of consumables – oxygenator /heat exchanger, cardioplegia delivery system, venous reservoir, filters and circuits.
- Priming, deairing of circuit, prebypass circulation, occlusion check.
- Connectors, cannulas and suction tubes
- Autologous blood saving, cardioplegia solution preparation
- ACT charting

3. Initiation and conduction of CPB

- Continuous assessment of adequacy of oxygenation, tissue perfusion, flow rates, venous return and level, leak-proof pathway and various pressures (arterial, aortic, central venous, pulmonary arterial, left atrial & cardioplegic line)
- Cannulation techniques and venting of heart,
- Cooling and cardioplegia delivery
- Additive drugs Warming and weaning off CPB: Conduct of CPB for adults undergoing - repair of septal defects, valve replacement And coronary arterial bypass
- Beating heart surgery and techniques of perfusion and myocardial protection

4. Cardiac surgery without CPB

- Patients' selection for less invasive operations (MID CAB, OPCAB), technical considerations in off-pump surgery, stabilizing devices, intra coronary stents, primary off-pump CABG in impaired left ventricular function, alternative approaches to coronary artery disease.

B. Pediatric Perfusion**1. General aspects of pediatric perfusion**

- Preparation for CPB- Equipment- Pump, & oxygenator Preparation of the Patient for CPB Blood Flow, Circuit selection, Priming Cannulas and Techniques, Conduct of CPB
- Myocardial protection, Hypothermia, Pulsatile versus non-pulsatile flow,
- Fluid and acid-base management & Metabolic parameters
- Blood Conservation Techniques

- Brain injury in infant cardiac surgery & neuroprotection
- ECMO for Neonates, Infants and Children Circulatory assist devices for Infants and children.

2. Management of specific pediatric conditions

- Cyanotic heart diseases: (TOF, TGA, Tricuspid atresia, Truncus arteriosus, TAPVC
- ii) Left to Right shunts: (PDA, ASD, VSD, APW, RSOV)
- iii) Miscellaneous: Ebstein's anomaly, Single ventricle, AV septal defect – partial & complete, Hypoplastic left heart syndrome

Paper III: Advanced perfusion & Special perfusion

A. Advanced perfusion

Heart and Heart – Lung Transplantation:

1. Heart transplantation

- Basic transplant immunology, Patient and donor selection, Matching donor to recipient, Donor preparation, Orthotropic/heterotrophic Cardiac transplantation, Intensive care management, Immunosuppression and rejection, Surgical complications and results.
- Contents of transplant kit, dimensions of transplant box for Heart, lung , heart and lung.
- TRANSMEDICS organ retrieval system.

2. Heart-lung transplantation

- Recipient selection, donor selection and graft harvest, surgical procedure, Pathophysiology before / after transplantation, preoperative management.

3. Lung transplantation

- Recipient selection, Donor selection and graft harvest, surgical procedures of ltmg transplantation (single-lung / double-lung transplantation), Pathophysiology before / after transplantation, postoperative management Perfades and perfadex plus solution for lung protection

4. Ventricular Assist devices (VAD) & Artificial Heart

5. Extracorporeal membrane oxygenators (ECMO)

6. Perfusion techniques during Minimally Invasive Cardiac Surgery (MICS)

7. **Recent advances in:** Heart lung machine, oxygenators, Circuits and cannulas, Myocardial protection techniques and additives, Cardioplegia, Monitoring - hemodynamic, neurologic, metabolic and blood gas parameters

8. **Recent advances in:** Anticoagulation maintenance, Heparin neutralization, Coagulation parameter tests, Thromboelastography, Leukocyte filtration, Ultrafiltration, Blood surface – interface: biomaterials and selective inhibition of blood elements.

9. **Perfusion for non-cardiac conditions:** Liver transplant, Lung transplant, Isolated limb perfusion, Respiratory failure, Massive acute pulmonary thromboembolism, Excision of giant arteriovenous malformation or highly vascular tumors –esp. neurologic tumors., Tracheal operations, Large mediastinal tumor excision, Renal tumor excision, Vena caval operations. Emergency cardiopulmonary support (ECPS), Severe chest injury – esp to aorta or trachea, Rewarming for severe hypothermia, HIPEC.

B. Special perfusion

CPB for ascending aortic aneurysms, aortic arch aneurysms, descending thoracic aortic aneurysms, thoraco-abdominal aortic aneurysm – cerebral and spinal cord protection, femoral cannulation, axillary cannulation.

1. Special Consideration in Perfusion

- Abnormal Hemoglobin & CPB
- CPB during pregnancy
- Malignant hyperthermia

2. Unusual problems or accidents during CPB and safeguard methods:

- Unexplainable air in arterial line and cavitation, air embolism,
- Unusual degree of hemolysis
- Inadequate venous drainage or air lock,
- Leaking circuit or oxygenator,
- Faulty pump function
- Faulty heat exchange,
- Severe hyperkalemia,
- Unexpected slippage of aortic cannula

3. Blood conservation strategies in cardiac surgery – techniques and pharmacologic agents

4. Heparin resistance, heparin induced thrombocytopenia and alternatives to unfractionated heparin - (Low molecular weight heparin, heparinoids, defibrogenating agents, direct thrombin inhibitors, factor inhibitors, platelet inhibitors & coated surfaces)

5. Intraaortic balloon pump – concepts and techniques.

6. Ultrafiltration – concept, types, and techniques

Practical

Conduct of CPB

Management of accidents during CPB

Recommended reading material**Textbook:**

1. The manual of clinical perfusion Bryan V Lich
2. Cardiopulmonary bypass - Sunit Ghosh
3. Anaesthesia for cardiac surgery- James A.Dinardo
4. Ecmo in the adult patient- AlainVuylsteke
5. Cardiac assists devices, Daniel J. Goldstein & Mehmei C.Oz, Futura Publishing Company
6. Cardiopulmonary bypass; Principles and practice. Glenn P. Gravelee, Richard F. Davis. Mark Kurusz&. Joe R. Utley: Lippincott Williams &Wilkins
7. Techniques in Extracorporeal circulation, Philip H. Kay & Christopher M. Munsch
8. Warm heart surgery, Tomas Antonio Salerno
9. Extracorporeal Life Support-Dan M. Meyer, M.D., Michael E. Jessen, M.D.
10. On Bypass - Linda B. Mongero, James R. Beck
11. Minimized cardiopulmonary bypass techniques and technologies- Terence Gourlay, SerdarGunaydin
12. Mechanical Circulatory Support - Wayne E, Richenbacher, Landes Bioscience
13. Extracorporeal Life Support for Adults--Gregory A Schmidt (eds.)- -Humana Press

COURSE AND EXAMINATION REGULATIONS

Attendance:

- Students are required to attend 75% or more of all theory classes held, and 75% or more of practical in each subject to be eligible to appear in the final examination. Under no condition will a student with less than the prescribed attendance in any subject in theory and practical separately shall be allowed to appear in the Annual examination of that subject.
- Students with less than 75% attendance in theory and practical separately at the end of any year must start afresh by joining the junior batch of students. No extra classes will be arranged to make such students eligible for the final annual examinations. The attendance accrued in the previous academic year in those subject(s) will not be transferred. The student will need to secure 75% attendance afresh in theory and practical/laboratory postings after joining the junior batch to become eligible to appear in the final summative examination.
- The 25% leverage in attendance includes all types of leaves (including leave on medical grounds). For absence because of illness or any medical condition, a duly approved medical leave from Dean (Academic) with medical and fitness certificate issued/verified by authorized JIPMER clinical faculty member is mandatory. Certificate must be submitted before or within 10 days after availing medical leave.
- Students who are detained in all the subjects of a year due to lack of attendance should join the classes with junior batch within 7 days of declaration of the eligibility/detention list or when classes commence, whichever is earlier.
- Students who are detained in one or more subject(s) because of lack of attendance but are eligible to appear for final Annual examination in at least one subject of the year should join classes with junior batch within 7 days of completion of the last final theory/practical examination or when classes, whichever is earlier. Attendance will be calculated from the date of joining.
- A show cause notice will be issued to students on continuous unauthorized absence without prior permission for two weeks or more. If such absence extends to a period more than one month for any reason, the student is liable for termination for the course. The decision of the competent authority is final.
- There is **no condonation permissible** for shortage of attendance.

Internal Assessment (IA)

- A minimum of three notified internal assessments will be held periodically in each year (in a one-year period) and one model examination before the final annual examination.
- Each of the notified IA tests will carry 20% weightage and the model examination will carry 40% weightage. The sum of notified IA tests and model examination will decide the eligibility to appear in the examination and for contribution to aggregate marks.

- A student must secure at least 30% of the maximum marks fixed for internal assessment in theory and practical/clinical separately in a particular subject to be eligible to appear for the final annual examination in that subject.
- Of the final total aggregate marks in each subject, internal assessment marks will contribute 40% and annual examination marks will contribute the remaining 60%. This will apply to both theory and practical/clinical papers separately.
- If a student misses up to one notified test because of illness, marks of the remaining notified tests can be considered for calculating the internal assessment, ignoring the absence on medical grounds. To avail this concession, the student should submit a valid medical certificate signed by the treating clinical faculty member of JIPMER before or within 10 days after the missed test. This exemption will not apply to model examination. This is applicable only up to one missed notified internal assessment test.
- No repeat/additional notified internal assessment or model examination will be conducted.
- Students who are detained in all the subjects of a year because of lack of sufficient internal assessment marks should join the classes with junior batch within 7 days of declaration of the eligibility/detention list or when classes of the year commence, whichever is earlier.
- Students who are detained in one or more subject(s) due to lack of sufficient internal assessment marks but are eligible to appear in the annual examination in at least one subject of the year should join classes with junior batch within 7 days of completion of the last annual theory/practical examination or when classes of the year commence, whichever is earlier.
- The internal assessment marks accrued in the previous year will not be transferred to the next year.

Annual Examinations

Number and timing of examinations

- Annual examinations will be held at the end of each academic year. The Institute shall conduct not more than two annual examinations in an academic year, a regular annual and a supplementary examination in each subject. The supplementary examinations will be held within 6 weeks after publication of the result of the regular annual examination.
- Practical Examinations shall be jointly conducted by one internal and one external examiner duly appointed by the Professor of Examinations.
- Students should obtain a minimum of 40% in the annual examination and a minimum of 50% in the final total aggregate (total of internal assessment and annual examination marks) in a subject (theory and practical separately) to be declared as pass in that subject.

Marks scheme:

	Maximum marks
Theory	200
Practical	100
Total	300

Theory

	Maximum marks
Internal Assessment test 1 (weighted)	16
Internal Assessment test 2 (weighted)	16
Internal Assessment test 3 (weighted)	16
Model Examination	32
Annual Theory Examination	100
Viva-voce Examination	20
Total Theory marks	200

Practical

	Maximum marks
Internal Assessment test 1 (weighted)	7
Internal Assessment test 2 (weighted)	7
Internal Assessment test 3 (weighted)	7
Model Examination	14
Record marks	5
Annual Practical Examination	60
Total Practical marks	100

Question paper pattern

	Maximum marks
Section A	50
Section B	50
Total	100

Each section

		Marks
Answer in detail	1 X 10	10
Short notes	5 X 5	25
Brief answers	5 X 3	15
		50

Number of attempts and Training Period

- The academic program of the BSc Allied Health Sciences courses must be completed within 6 years from the date of joining (excluding internship). Maximum permissible duration for each year shall be four years and a maximum four attempts (including the annual and supplementary examinations) in any subject will be permitted.
- If a student does not appear in both theory and practical final examination, it will NOT be considered as an attempt for the purpose of calculation of maximum number of attempts in a subject.
- If a student appears for theory in the Annual Examination but does not appear for Practical Examination or vice-versa, his/her theory or practical appearance shall be counted as an attempt. In the next attempt, the student will have to appear for both Theory and Practical Examinations. Mere submission of application form for examination will not be considered as an attempt.
- Passing in the exams of all the previous year subjects is compulsory before proceeding to the classes of next phase.
- A student who fails in theory and/or practical papers of one or more subjects in the regular annual examinations at the end of each year can appear in the supplementary examination (to be held within 6 weeks of announcement of the regular annual examination results) in those subjects.
- If he/she passes these subjects in the supplementary examination, he/she should join the regular batch within 7 days of declaration of supplementary examination results or when classes commence, whichever is earlier. Attendance calculation for students who join after passing supplementary examination will begin from their date of joining of that year.
- Students who fail in theory and/or practical in one or more subjects in the supplementary examination and those who do not appear in the supplementary examination should join classes with the junior batch within 7 days of declaration of supplementary examination results or when classes, whichever is earlier. These students should secure 75% attendance and 30% internal assessment afresh to be eligible to appear in the final regular annual examination of that year along with the junior batch. Attendance calculation for students who join after failing in supplementary examination will begin from their date of joining the year with junior batch.
- A maximum of four attempts in any subject is allowed. If a student fails even in the 4th attempt, no further chances will be given, and his/her name will be struck off the rolls of JIPMER.
- No grace marks will be awarded for either theory or practical examinations under any circumstances.

Model Question paper**Phase I - Paper I: Foundation course**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

- a. Describe in detail healthcare delivery system in India at the primary, secondary, and tertiary levels.

2. Write short notes on the following:

5 x 5 = 25

- a. What is the role of processor and RAM in a computer?
- b. Describe the types of networks in computing.
- c. Write a short note on right to healthcare.
- d. What is medical negligence? What are the laws governing medical negligence in India?
- e. Write in brief about the importance of informed consent and the process.

3. Answer the following questions briefly:

5 x 3 = 15

- a. What are the components of a medical term?
- b. What are the input and output devices of a computer?
- c. What is paralanguage? What are its implications?
- d. Describe the characteristics of good communicator.
- e. What are the alternative medicine systems recognised by the Government of India?

Section B**4. Answer the following question in detail:**

1 x 10 = 10

- a. Explain the concepts of quality of care. Describe various approaches to quality improvement.

5. Write short notes on the following:

5 x 5 = 25

- a. Describe the principles of management with suitable examples.
- b. Describe the methods of disinfection in biomedical waste management.
- c. Describe the methods of prevention & control of common healthcare associated infections.
- d. Classify the types of antibiotic resistance and describe each of them.
- e. Write a short note on research study designs.

6. Answer the following questions briefly:

5 x 3 = 15

- a. What are the components of cardiopulmonary resuscitation?
- b. What is integrity and what is its importance of integrity in healthcare practice?
- c. What are the qualities of a good leader?
- d. What are the different types of data?
- e. Describe the concept of ethics and its relevance in healthcare practice.

Model Question paper**Phase I - Paper II: Anatomy and Physiology**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A - Anatomy**1. Answer the following question in detail:** 1 x 10 = 10

- a. Describe the position, parts, structure, blood supply and supports of uterus.

2. Write short notes on the following: 5 x 5 = 25

- a. Parts and blood supply of stomach
b. Simple epithelium
c. Histology of lymph node
d. Chambers and valves of heart
e. Surfaces and lobes of lung

3. Answer the following questions briefly: 5 x 3 = 15

- a. Name three major salivary glands.
b. Mention two contents of spermatic cord
c. Name two paranasal air sinuses
d. Name the parts of small intestine
e. Name two upper limb muscles

Section – B - Physiology**4. Write essay answer on the following:** 1 x 10 = 10

- a. Define immunity. Mention the different types of immunity. Write briefly about the different types of immunity. (2+2+6)

5. Write short notes on the following: 5 x 5 = 25

- a. Active transport
b. Movements of small intestine
c. Factors affecting glomerular filtration rate
d. Oxygen haemoglobin (Oxy-Hb) dissociation curve
e. Factors regulating cardiac output

6. Answer the following questions briefly: 5 x 3 = 15

- a. Name the hormones secreted from Adrenal gland
b. Mention the Indicators of ovulation
c. Define tidal volume. Mention its normal value.
d. Draw a labelled diagram of lead II ECG.
e. List four functions of hypothalamus.

Model Question paper**Phase I - Paper III: Pathology and Microbiology**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A - Pathology**1. Answer the following question in detail:**

1 x 10 = 10

- a. What is inflammation? What are the cardinal signs of inflammation? Mention the difference between acute and chronic inflammation. Add a note on granuloma with example. (1+2+4+3)

2. Write short notes on the following:

5 x 5 = 25

- a. Define necrosis. Give examples of different types of necrosis. Differences between necrosis and apoptosis.
- b. What is thrombosis? Explain Virchow's triad.
- c. Define neoplasia. What are the differences between benign and malignant tumours? List the different routes of metastasis.
- d. Mention the differences between wound healing by primary and secondary intention.
- e. Principles and procedures of blood grouping and cross-matching.

3. Answer the following questions briefly:

5 x 3 = 15

- a. Define anaemia. Give any two causes of anaemia.
- b. What is jaundice? Give the classification based on pathophysiology.
- c. What is atherosclerosis? Give some of its risk factors.
- d. What is nephrotic syndrome? Give any two examples.
- e. How will you do urine analysis?

Section – B - Microbiology**4. Write essay answer on the following:**

1 x 10 = 10

- a. Define sterilization. Draw a labelled diagram of autoclave. Write principle of autoclave and its application in hospital. (1+3+3+3)

5. Write short notes on the following:

5 x 5 = 25

- a. Enumerate vector borne diseases. Add a note on the laboratory diagnosis of malaria
- b. What do you understand by segregation of biomedical waste? How is it done in your hospital?
- c. Describe in detail about various method of urine sample collection
- d. Enumerate sexually transmitted microorganisms. Write laboratory diagnosis of HIV
- e. Describe laboratory diagnosis of Mucormycosis.

6. Answer the following questions briefly:

5 x 3 = 15

- a. Name two transport media
- b. Name two foodborne pathogens
- c. Enumerate four Personal Protective Equipment (PPE)
- d. Name two nosocomial pathogens
- e. List two opportunistic fungal infection

Model Question paper**Phase I - Paper IV: Introduction to Perfusion Technology**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

a. Explain in detail the uses, principles, components of heart lung machine used in cardiac surgery.

2. Write short notes on the following:

5 x 5 = 25

- a. What are the principles of Open heart surgery?
- b. What is Cardioplegia? Mention any two types and describe the mechanism of action of any one type of cardioplegia.
- c. Write short notes on controlled cross circulation.
- d. List the various types of aortic and venous cannulae.
- e. Write in brief the development of various generations of Oxygenator.

3. Answer the following questions briefly:

5 x 3 = 15

- a. Mention the role of Heater-cooler machine during cardiopulmonary bypass.
- b. Mention names of any three cardiac surgeries.
- c. What is the role Aortic cross clamp used in cardiac surgery?
- d. Mention different suckers used in cardiac surgery.
- e. Mention any three catheters used in cardiac surgery.

Section B**4. Write essay answer on the following:**

1 x 10 = 10

- a. Describe in detail the basic and advanced resuscitation for life support.

5. Write short notes on the following:

5 x 5 = 25

- a. Write the mechanism of action and uses of any two Anticoagulants used in cardiac surgery.
- b. Describe the mechanisms by which hypothermia helps in safe conduct of cardiopulmonary bypass.
- c. Write short notes on potassium and cardiac surgery.
- d. Discuss briefly anticoagulation monitoring during cardiopulmonary bypass.
- e. What is electrocardiogram? Mention any four clinical conditions in which changes observed in ECG are of diagnostic importance.

6. Write very short answers on the following:

5 x 3 = 15

- a. What is Inflow occlusion? In which surgery was it used?
- b. Mention any two anaesthetic agents.
- c. What is roller pump?
- d. What is meant by venting of heart?
- e. List any three names of drugs used during the cardiopulmonary bypass.

Model Question paper**Phase II - Paper I: Applied Anatomy and Physiology**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:** 1 x 10 = 10

- a. Explain in detail about the anatomy of coronary arteries and veins with a diagram

2. Write short notes on the following: 5 x 5 = 25

- a. Segments of a bronchial tree.
b. Differentiate the anatomy of right and left lung.
c. Coverings of the heart.
d. Explain circle of Willis with a labelled diagram.
e. Major branches of thoracic and abdominal aorta.

3. Answer the following questions briefly: 5 x 3 = 15

- a. What are alveoli?
b. What is the surface area of the lung?
c. What are the branches of aortic arch?
d. What are the layers of the arteries?
e. What is moderator band and its location?

Section B**4. Write essay answer on the following:** 1 x 10 = 10

- a. Define cardiac cycle. Explain in detail about the phases of cardiac cycle.

5. Write short notes on the following: 5 x 5 = 25

- a. Lung surfactant
b. Factors affecting cardiac output.
c. Explain about oxy-haemoglobin dissociation curve.
d. Components of Blood with its composition.
e. Define Fick's principle and its clinical application.

6. Write very short answers on the following: 5 x 3 = 15

- a. Define Frank – Starlings law.
b. What is the pacemaker of the heart?
c. Write the flow chart of systemic and pulmonary circulation.
d. What is Bohr's effect?
e. What is the normal coronary blood flow rate?

Model Question paper**Phase II - Paper II: Applied pathology and Applied Pharmacology**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

- a. Describe the Pathophysiology, Clinical manifestations, complications and treatment of rheumatic mitral stenosis.

2. Write short notes on the following:

5 x 5 = 25

- a. What are the various components of Tetralogy of Fallot? Explain the reason for cyanosis in TOF with an illustrative diagram?
- b. What is cor pulmonale? Discuss its aetiology and clinical manifestations?
- c. What is single ventricle physiology? Mention two cardiac malformations with single ventricle physiology.
- d. What are the different types of pleural effusion? Mention its various causes and the pathophysiology of cardiac cause of pleural effusion?
- e. List any three cardiac tumours. Explain how the clinical presentation of cardiac myxoma can mimic valvular heart disease.

3. Answer the following questions briefly:

5 x 3 = 15

- a. Mention two atrial arrhythmias.
- b. What is Eisenmenger syndrome?
- c. Mention two chronic suppurative pulmonary disease.
- d. What is ARDS? What are the diagnostic criteria based on ABG analysis?
- e. Classification of Aortic dissection.

Section B**4. Write essay answer on the following:**

1 x 10 = 10

- a. What are the antiarrhythmic agents? Classify and describe their mode of actions. Mention examples for drugs in each class.

5. Write short notes on the following:

5 x 5 = 25

- a. Loop diuretics with examples.
- b. Explain the pharmacodynamics and pharmacokinetics of Heparin.
- c. ACE inhibitors – mode of action and indication.
- d. Aspirin – Mode of action, clinical uses, and adverse effects.
- e. Write about coronary vasodilators?

6. Answer the following questions briefly:

5 x 3 = 15

- a. Drugs used in the treatment of atrial fibrillation.
- b. What is verapamil and mention its indication?
- c. Metoprolol – identify the class of drug.
- d. Mention two osmotic diuretics?
- e. Steroids– Mode of action as an anti-inflammatory agent.

Model Question paper**Phase II - Paper III: Biomedical Engineering and Fundamental Perfusion Technology**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

- a. Explain the working principle of transducers. Describe the types of mechanical transducers.

2. Write short notes on the following:

5 x 5 = 25

- a. Explain about the Einthoven Triangle.
- b. Explain the formation of laser.
- c. Differentiate AC and DC.
- d. Describe Diathermy
- e. Working principle of fiber optics

3. Answer the following questions briefly:

5 x 3 = 15

- a. Define Darcy's law.
- b. Define coupling and mention a device that works on its principle.
- c. State OHM's law.
- d. What is LED?
- e. Mechanism and usage of fuse.

Section B**4. Write essay answer on the following:**

1 x 10 = 10

- a. What are the different types of pumps used for cardiopulmonary bypass? Describe their structure, functions, merits, and demerits.

5. Write short notes on the following:

5 x 5 = 25

- a. What are the adverse reactions of Blood product transfusion?
- b. Write about the working principle of a cell saver machine and its clinical uses.
- c. Pre-bypass checklist.
- d. Classify the types of priming fluid and its significance.
- e. Write in detail about bubble oxygenator.

6. Answer the following questions briefly:

5 x 3 = 15

- a. Define the "reaction time"?
- b. Define Priming?
- c. Types of oxygenator?
- d. What is Cardiopulmonary Bypass?
- e. Write the formula used for bicarbonate correction?

Model Question paper**Phase III - Paper I: Pathophysiology of Cardiopulmonary bypass I & II**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

- a. What is the purpose of cardioplegia? Mention different types & modes of delivery with merits and demerits?

2. Write short notes on the following:

5 x 5 = 25

- a. What is spallation?
- b. What are the effects of total circulatory arrest during CPB?
- c. Define Protamine and its adverse reactions.
- d. How to perform retrograde autologous priming and its advantages?
- e. Write short notes on Merits and Demerits of On pump vs Off pump coronary bypass surgery.

3. Answer the following questions briefly:

5 x 3 = 15

- a. What is the desired ACT level to be maintained during cardiopulmonary bypass?
- b. Heparin resistance.
- c. Conditions in which Aortic root Cardioplegia is not effective?
- d. Define Endoclamp?
- e. What is the safest duration for DHCA?

Section B**4. Write essay answer on the following:**

1 x 10 = 10

- a. Define air embolism its causes and management during CPB?

5. Write short notes on the following:

5 x 5 = 25

- a. What is the use of TCD (Transcranial Doppler) during CPB?
- b. Difference between pulsatile and non-pulsatile flow.
- c. Explain the causes & effects of poor venous return during CPB.
- d. What is myocardial stunning?
- e. Factors determining oxygen carrying capacity of haemoglobin.

6. Answer the following questions briefly:

5 x 3 = 15

- a. What are the causes of haemolysis during CPB?
- b. What are the effects of serum calcium and magnesium?
- c. Mention few prostaglandins released during SIRS?
- d. What is oliguria?
- e. How is myocardial distension managed during CPB?

Model Question paper**Phase III - Paper II: Clinical application of Cardiopulmonary bypass & Paediatric perfusion**

Maximum marks: 100 Maximum duration: 3 hours
 Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

- a. Draw and explain the CPB circuit with all the components assembled for the surgery involving replacement of aortic arch?

2. Write short notes on the following:

5 x 5 = 25

- a. Describe the uses of cardiac venting & its placement.
- b. What are the parameters monitored during CPB to ensure adequacy of perfusion?
- c. What is the purpose of arterial filter and where it is incorporated in the CPB circuit?
- d. Write down the checklist of weaning from CPB.
- e. What is Modified Ultrafiltration? How is it done?

3. Answer the following questions briefly:

5 x 3 = 15

- a. Role of adenosine in CPB.
- b. What are Thebesian veins?
- c. Abbreviation of EOPA cannula and its use.
- d. What is the preferred rate of cooling and rewarming during CPB?
- e. What are the various sites of temperature monitoring?

Section B**4. Write essay answer on the following:**

1 x 10 = 10

- a. What are the differences in conducting CPB (cardiopulmonary Bypass) in children and adult?

5. Write short notes on the following:

5 x 5 = 25

- a. Write a note on Delnido cardioplegia?
- b. What are the indications of ECMO in pediatric group of patients?
- c. Principles of Fontan procedure.
- d. Persistent Left Superior venacava – Methods to manage during open heart procedures.
- e. Fluid management in neonates during cardiopulmonary Bypass.

6. Answer the following questions briefly:

5 x 3 = 15

- a. What is cold necrosis?
- b. What is “no-reflow” phenomenon?
- c. How do infants differ from adults in the cortex of BSA? How do you calculate BSA in infants?
- d. What are the different types of Ventricular Septal Defect?
- e. Mention any four cardiac malformations which causes pulmonary artery hypertension when left untreated.

Model Question paper**Phase III - Paper III: Advanced perfusion & Special perfusion**

Maximum marks: 100

Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A**1. Answer the following question in detail:**

1 x 10 = 10

- a. What is total artificial heart? Describe in detail about its indications, mode of operation and complication?

2. Write short notes on the following:

5 x 5 = 25

- a. Explain about HIPEC.
- b. Explain about LVAD and its indication & complications.
- c. Write about the principle, indications, and contraindications of IABP.
- d. What are the components of Bretschneider's cardioplegia and its function?
- e. Explain about isolated Limb perfusion.

3. Answer the following questions briefly:

5 x 3 = 15

- a. Who invented the permanent artificial heart? What was the name of the heart?
- b. On what principle does a centrifugal pump work?
- c. What are the features of the Bio-Medicus Next generation Femoral Venous cannula?
- d. What are surface modifying additives?
- e. Causes of retrograde flow in ECMO?

Section B**4. Write essay answer on the following:**

1 x 10 = 10

- a. Describe various methods of blood conservation strategies in open heart surgery.

5. Write short notes on the following:

5 x 5 = 25

- a. How does pregnancy differ from other physiological states in adult females with relevance to CPB?
- b. What are the factors influencing the efficacy of ultrafiltration?
- c. How is hyperkalemia managed during CPB?
- d. What are the triggers for IABP inflation and deflation?
- e. Write in detail about left heart bypass?

6. Answer the following questions briefly:

5 x 3 = 15

- a. What is Argotroban? How does it act and mention its uses?
- b. Which gas is used in Intra Aortic Balloon Pump and why?
- c. What is antegrade cerebral perfusion and the rate of flow?
- d. Draw the schematic representation of a diamond circuit for CPB?
- e. Name the solution used for preserving the donor heart during heart transplantation surgery
