

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



BSc Cardiac Laboratory 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) – Cardiac Laboratory 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.

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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 Cardiology

The Department of Cardiology was first established in 1987. The first cardiac catheterization lab started functioning in 1995. The Department moved to the Super Specialty Block, its present location, in 2009. While the Cardiology OPD, Department office, Echocardiography suites, ECG cum Holter room, Treadmill room, 2 cardiac catheterization laboratories, Cardiology ward and SSB-Cardiac coronary care unit operate from the Super Specialty Block, the EMS- Cardiac coronary care unit and EMS cardiac catheterization lab are functional in the 2nd floor of EMS block. With Echocardiography, ECG, TMT, and Holter services providing a strong non-invasive diagnostic platform, the three cardiac catheterization labs provide state of the art diagnostic and therapeutic interventional and Electrophysiology services including FFR, Rotablation, OCT, (Optical Coherence Tomography) and comprehensive electrophysiology mapping including three-dimensional mapping. The Department takes pride in maintaining its status as a centre for excellence in Cardiology.

Nomenclature: BSc (Allied Health Sciences) – Cardiac Laboratory Technology

Introduction:

Cardiology is an advanced medical field specialising in the health of heart and blood vessels. The field has progressed exponentially in the last several decades and today, several advanced techniques are available for early diagnosis, and timely treatment of various cardiovascular diseases. Advanced diagnostic and treatment equipment in the departments of Cardiology require expert hands for managing and maintaining them so that services can be delivered promptly to patients. This is a bachelor course in which students are trained with a wide spectrum of knowledge in cardiovascular procedures.

Objectives of the course:

The aim of the course is to impart appropriate knowledge and skills to work closely with the Cardiologist and perform the following:

- perform and interpret electrocardiograms and Holter recordings
- perform cardiac treadmill stress tests
- assist the Cardiologist in echocardiography and stress echocardiography
- assist the Cardiologist in diagnostic and therapeutic percutaneous coronary and peripheral catheterisation procedures
- assist the Cardiac Electrophysiology specialist in electrophysiology procedures

Course overview:**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 and introductory concepts on cardiac lab technology.

Second phase: one year

In the second phase, students will gain theoretical and practical knowledge in Non-invasive cardiac procedures such as Electrocardiogram including Holter recording, Cardiac physiology, stress testing, and echocardiography including stress echocardiography.

Third phase: one year

In the third phase, students will gain theoretical and practical knowledge in invasive cardiac procedures such as angiography, placement of pacemakers, electrophysiology, interventional cardiac procedures and care of patients in cardiac intensive care.

Internship: one year

Internship of one year is compulsory. During the period of Internship, students will be able to acquire comprehensive knowledge about non-invasive and invasive cardiological procedures. Students will receive intensive training in both invasive and non-invasive cardiac laboratories in handling and maintenance of various cardiac imaging equipment.

Expectations from the future graduate

The future graduate has options of working in cardiac catheterization laboratories as cardiac catheterization laboratory technologist or echocardiographer or ECG technician in cardiology departments across the country and abroad. Options of post-graduation in cardiac lab technology/ other basic sciences are open to candidates opting to pursue higher education.

Available postgraduate programmes in India

1. PG Diploma in SCTIMST, Thiruvananthapuram, Kerala
2. PG Diploma in Christian Medical College, Vellore, Tamil Nādu
3. PG Diploma in NIMS Hyderabad
4. MSc Cardiac Catheterization and intervention technology at Manipal University, Manipal Academy of Higher Education, Karnataka.

Job profile

After completion of the course, the graduates would get an opportunity to work as a Cardiac Technologist in super specialty hospitals, general hospitals or cardiac centres, and would be competent to perform and interpret Electrocardiogram, Cardiac Treadmill testing, Holter Recording and Echocardiogram. They would be able to assist interventional cardiologist in performing coronary & peripheral angiogram, percutaneous coronary intervention and device closure of congenital cardiac defects by providing their technical knowledge & support, and they would also assist in Cardiac Electrophysiology procedures as well.

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 Cardiac laboratory technology & Biochemistry (T & P)
II	I	Electrocardiogram including Holter recording (T & P)
	II	Cardiac Physiology, stress testing and stress echocardiography (T & P)
	III	Echocardiography (T & P)
III	I	Angiography and Haemodynamics (T & P)
	II	Pacemakers and Cardiac Electrophysiology (T & P)
	III	Interventional Cardiology & Cardiac Intensive care (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 Cardiac laboratory technology	30	280	
	Biochemistry	30		
	Self-study/Library			60
Total				1080
II	Electrocardiogram including Holter recording	60	280	
	Cardiac Physiology, stress testing and stress echocardiography	60	280	
	Echocardiography	60	280	
	Self-study/Library			60
Total				1080
III	Angiography and Haemodynamics	60	280	
	Pacemakers and Cardiac Electrophysiology	60	280	
	Interventional Cardiology and Cardiac Intensive care	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 dispatch 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 dispatch 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. RL Ichhpujani, 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 Cardiac laboratory technology & Biochemistry**Section A:**

- Basic cardiac laboratory functions and Non-invasive and invasive cardiac laboratory setup
- Introductory concepts of cardiac laboratory techniques
- Basics of cardiac catheterization techniques
- Basics of common cardiac emergencies
- Instruments and equipment related to cardiac laboratory
- Functional anatomy and physiology of cardiovascular system
- Principles of basic cardiovascular examination and vital signs
- Basic principles and components of electrocardiogram and echocardiography

Section B: General Biochemistry

- Carbohydrate chemistry: Monosaccharides, Disaccharides and Polysaccharides in health and disease
- Lipid chemistry: Simple, compound, and derived lipids, Lipoproteins in health and disease
- Protein chemistry: Amino acids, protein structure, protein denaturation
- Enzymes: Coenzymes, classification, Types of enzyme inhibition, Factors affecting enzyme activity; Clinical enzymology
- Nucleic acid chemistry: DNA, RNA
- Vitamins: Dietary sources, recommended dietary allowance, functions, and deficiency / toxicity of Vitamins
- Minerals: Dietary sources, recommended dietary allowance, functions, and deficiency / toxicity of Minerals
- Nutrition: basal metabolic rate, Protein Energy Malnutrition, Obesity, Food adulterants / additives
- Diabetes and Oral glucose tolerance test: Diagnosis and complications of diabetes,
- Renal and liver disease: RFT, LFT
- Myocardial infarction and Lipid profile: Cardiac markers

Recommended Textbooks (latest edition): Introduction to Cardiac laboratory technology

1. Leo Schamroth. An Introduction to Electrocardiography
2. Marriott's Practical Electrocardiography
3. Goldman MJ. Principles of Clinical Electrocardiography
4. Textbook of Echocardiography-Catherine Otto.

Recommended Textbooks (latest edition): General Biochemistry

1. Medical laboratory Procedure Manual (T-M) by K.L. Mukerjee 1987, Vol.I, II & III
Tata McGraw Hill Publication.
2. Textbook of Medical Biochemistry by Ramakrishna
3. Textbook of Clinical chemistry by Norbert Teitz.
4. Principles and Techniques of Practical Biochemistry by Wilson and Walker.
5. Clinical Chemistry - Principle and techniques by Rj Henry, Harper & Row Publishers.
6. Textbook of Biochemistry by Vasudevan and Sree Kumari.

Phase II

Paper I: Electrocardiogram and Holter Recording

Theory:

- Introduction to ECG, ECG Apparatus, Bipolar Standard Leads, Bipolar Chest Leads, Unipolar Leads, Unipolar extremity Leads, Unipolar Precordial Leads, Monitor Leads, Relation between Unipolar Extremity Leads & Standard Bipolar Leads.
- Electrophysiology of the Heart: Intracellular Potentials, Electrical Potentials produced by normal cardiac muscle.
- Cardiac Electrical Activity: Anatomic Orientation of the Heart, The Cardiac cycle, Cardiac impulse formation and conduction, Recording Long and Short axis of cardiac electrical activity.
- Recording the Electrocardiogram: Evolution of Frontal Plane Leads, Transverse plane Leads, Correct and incorrect leads placement, display of the 12-lead standard ECG.
- Interpretation of the Normal ECG: ECG features, Rate and Regularity, P-Wave morphology, PR interval, QRS morphology, ST-segment, T-wave & U wave morphology, QTc interval, Cardiac rhythm, ECG in Infants & Children, Normal Variants of the Adult ECG, Dextrocardia & Dextroversion, Technical Dextrocardia.
- Abnormal Wave Morphology: Chamber Enlargement: Atrial enlargement, systematic approach to the evaluation of Atrial enlargement, Ventricular Enlargement (RV, LV dilation, Hypertrophy) Systematic approach to the Evaluation of Ventricular enlargement.
- Intraventricular Conduction abnormalities: Normal conduction, Bundle Branch (BB) and Fascicular blocks, Systematic approach to the Analysis of BB and Fascicular blocks
- Myocardial Ischemia and Infarction: Introduction, ECG changes during myocardial ischemia, injury and infarction, Ischemia, and Injury due to increased myocardial demand, changes in the ST-segment and T wave, Ischemia and Injury due to insufficient Blood supply-changes in the ST segment T-wave, and QRS complex.
- Myocardial Infarction: Changes in the QRS complex, QRS complex criteria for Diagnosis of infarction, localizing Infarction, Estimating Infarct size, Changes in the ST segment and T wave.
- Miscellaneous conditions: Cardiomyopathies, Pericardial Abnormalities, Pulmonary Abnormalities Intracranial Haemorrhage, Endocrine and Metabolic Abnormalities, Electrolyte Abnormalities, drug effects.
- Abnormal Rhythms: Introduction to Arrhythmias, Approach to arrhythmia diagnosis, problems of Automaticity, impulse conduction (block & re-entry). Brady and Tachyarrhythmia, SVT, VT, VF, wide QRS Tachycardia
- Introduction to Holter Recordings: Principles and Techniques, Indications, Equipment, Data Retrieval and Storage. Reporting

Practical:

1. Types of ECG Equipment: Proper handling and maintenance of Equipment
2. Patient information and patient privacy
3. Connecting ECG electrodes, ECG recording, standardization, writing correct name and ID of the patient.
4. Performing bedside ECG
5. Maintenance of Equipment and maintenance of the records
6. Troubleshooting
7. Proper communication with the patients
8. Holter Recording-Practical Aspects, Equipment and Connections, Recording and Storage

Textbooks recommended: (Latest edition)

1. Leo Schamroth. An Introduction to Electrocardiography
2. Marriott's Practical Electrocardiography
3. Goldman MJ. Principles of Clinical Electrocardiography

Paper II: Cardiac Exercise Physiology, Stress testing and Stress echo**Theory:**

- Cardiovascular and pulmonary responses to exercise: Type of Exercise, Exercise Physiology Maximum Oxygen Uptake, Myocardial Oxygen uptake, Heart rate Response, Arterial Blood pressure response etc.
- Relative & absolute Indication, contraindication, Termination of Exercise, Testing Procedures: Subject preparation, Electrocardiographic Recording, Equipment and protocols, test supervision and interpretation, post exercise period
- Four level angina scale for exercise tolerance test. Metabolic equivalent. etc
- Complication secondary to exercise tests.
- Interpretation; clinical response: -symptoms, subject appearance, physical examination, exercise capacity.
- Hemodynamic response; blood pressure, HR during exercise, Borg scale for rating perceived exertion.
- Normal and abnormal ECG Response; P, QRS, T, U Wave changes, ST-segment depression, elevation, ST-Segment elevation in Post-MI patient. Conduction abnormalities.
- Diagnostic value of the exercise test, prognostic use of the exercise test, exertional hypotension. Cardiac events in-patient with silent ischemia. Exercise parameters associated with poor prognosis and/or increased severity of CAD. Other uses of exercise test.
- Drugs and exercise testing; Beta blockers, vasodilators, ACE-Inhibitors, calcium antagonists, digitalis, other drugs.
- Special cases of exercise testing interpretation.

Practical:

1. Types of TMT Equipment: Proper handling and maintenance of Equipment
2. Getting familiarize with different TMT protocols
3. Patient information and patient privacy
4. Performing TMT
5. Interpretation of ECG changes during exercise and recovery
6. Reporting and Data Storage

Textbooks recommended: (Latest edition)

1. Ellestedt's Principles of Exercise Electrocardiogram.
2. Manual of Exercise Electrocardiogram-Edward. Hung

Paper III: Echocardiography

Theory:

- Physical principles, instrumentation, and routine examination: -
- Properties of ultrasound, the transducer, Echocardiography
- Basic Principles of Echocardiography-Equipment and Instrumentation
- Indications for Echo
- Trans Thoracic Echocardiographic examination
- Standard plane position-standard imaging planes;
- Parasternal long axis, parasternal short axis, Apical views, Subcostal views suprasternal views
- M mode echocardiography
- Principles of Doppler flow images;
- The Doppler Effect, frequency description and analysis, Application of sampling theory to Doppler signal analysis, Limitation in the direct application of the Doppler equation to clinical velocity & Bernoulli's equation for velocities
- Doppler instrumentation;
- Doppler pulse transmission, summary of factors affecting Doppler sensitivity
- Principles of flow;
- Structure of blood and its relation to ultrasonic scattering, blood flow, hydraulic energies, pulsatile flow, vessel diameter, velocity profile
- Principles of color flow imaging;
- The color flow mapper, interrelationship of velocity resolution, depth of field, line density and frame rate
- Color Doppler spatial, temporal and velocity resolution
- Trans esophageal Echo-Indications, contraindication, indications, equipment and transducers, patient preparation, image recording, views, and interpretation.

Practical:

1. Introduction to Echocardiography machines and Transducers, Proper handling, and maintenance of Equipment
2. Getting familiarize with different transducer probes
3. Patient preparation and Patient privacy
4. Assisting, Reporting Echocardiography
5. Bedside Echocardiography
6. Performing transthoracic Echocardiography –adult
7. Understanding basic views
8. Interpretation of Echocardiography Images
9. Reporting and Data Storage
10. Patient preparation for Trans oesophageal Echocardiography
11. Rotations in Cardiac CT/MRI unit
12. Rotations in Nuclear Cardiology
13. Assisting Cardiac Perfusion and Scintigraphy studies

Textbooks recommended: (Latest edition)

1. Textbook of Echocardiography-Catherine Otto.
2. Feigenbaum's textbook of Echocardiography.
3. Braunwald's Heart Disease
4. Hurst's The Heart
5. Manual of Cardiovascular Medicine-Brian Griffith

TEACHING LEARNING ACTIVITIES:

The course content will be covered by:

1. Lectures
2. Group Discussions
3. Practical
4. Demonstrations
5. Clinical lab postings
6. Seminars
7. Assignments.

Phase III

Paper I: Angiography and Haemodynamics

Theory:

- Introduction to Cardiac catheterization laboratory.
- X-ray Theory: Electric to Electromagnetic Energy, Electromagnetic Radiation, Quantum Theory & X-Ray photons, X-ray Tube, X-ray Production, Characteristic of radiation, Bremsstrahlung radiation, Radiation Safety-scattering, Classical scattering, Compton scattering, Photoelectric effect, Differential absorption, Biological effects of radiation exposure, X-ray exposure, personal monitoring devices.
- Image detection in the cath lab, X-ray Image Intensifier Tube, Image recording, Digital Radiography, Subtraction Angiography, Digital storage of Images, DICOM cross platform standard, General cath lab supplies, Specific case supplies, Manifolds, Pulse Oximeter.
- Defibrillators, Defibrillation Vs. Cardio version, Intra-aortic Balloon pump (IABP), contrast Media, contrast media complications/side effects, contrast media power injector. Methods of preventing contrast complications.
- Hemodynamic Physiology: Cardiac Metabolism, Cardiac cycle: Atrial events, Ventricular events, arterial events, Cardiac output, Cardiac Reserve, stroke volume, Normal Pressure Values, Frank-Starling Principle, Combined Factors determine Cardiac output, preload, afterload and contractility.
- Hemodynamic Waveforms
- Cardiac Output: Angiographic Technique, Dilution Methods, The Fick Technique, Isocyanine Green Dye Dilution, Thermo dilution Technique. AO₂, SAO₂, PAO₂
- Hemodynamic Calculations: Cardiac Output Methods, Oxygen Capacity, Oxygen Content, AVO₂ Difference, Oxygen Consumption, Cardiac Output, Cardiac Index, Goblin calculations.
- Valve Area Calculations, Regurgitant Fraction, Pulmonary Vascular Resistance, Systemic Vascular Resistance.
- Hemodynamic Waveforms: Transducer, Wheatstone Bridge strain Gauge, Manifolds, Great Vessel Waveforms, Normal Pressure Values, Arterial Pressure Waveforms, Mean Arterial Pressure, Pressures of all chambers, LA, RA, LV, RV; Pulse Pressure, Ventricular Pressure Waveforms, Pullback Procedure, Atrial Pressures, Pulmonary Wedge Pressure, Ventricular Pressures, Pulmonary Artery pressure Aortic Stenosis & Insufficiency Effects.
- Vascular access- Femoral arterial and venous, Radial artery access and unusual sites. Puncture related complications. Vascular access compression and management of vascular complications.
- Coronary Angiography: Coronary Arteries and Veins, Coronary Artery System, Coronary Artery Dominance, Coronary Veins, Coronary Angiography: RAO Projection,

LAO projection, AP and Left Lateral projections, AP-cranial, cranio-caudal, hepatojugular view projection view summary, imaging sequence.

- Theory of Cardiac catheterization: Protocol, Contraindications, Complications, Cardiac catheterization entry sites- arterial access, radial access, cut down, Heart procedures: Left Heart procedure, Right heart procedure, combined heart procedure.

Practical:

1. Cardiovascular laboratory technology during cardiac catheterization,
2. Training to create and maintain and monitor the intravascular pressures
3. ECG Monitoring
4. Manning the Procedure table movements
5. Operate the catheterization lab screening equipment
6. Connection of Angiographic contrast injectors
7. Process the cine films
8. Blood oxygen saturation estimation during the procedure
9. Proper concentration on sterility maintenance,
10. Maintain a proper hospital record of the procedures.

Textbooks recommended: (Latest edition)

1. Textbook of Cardiac Angiography and Haemodynamics-Grossman.
2. Textbook of Cardiac Catheterisation-Morton J Kern
3. Angiocardiography-Freedom

Paper II: Pacemakers and Cardiac Electrophysiology

Theory:

- Cardiac pacemakers and defibrillation:
 - Basic concepts of the pacemakers
 - Pacemakers modes
 - Temporary pacemakers
 - Permanent Pacemakers
 - Single chamber and dual chamber pacemakers
 - Biventricular Pacemakers
 - Indication of Pacing
 - Coding of Pacemakers
 - Pacemaker parameters
 - Pacemaker programing
 - Pacemaker testing and surveillance
- Electrophysiology-Basics, Intracardiac electro grams, Identifying atrial and ventricular potentials, His bundle electrocardiograms.
- Indications and Techniques of Single and Dual Chamber Pacemakers. Complications.
- Intracardiac Defibrillators (ICD)- Indications and Procedure and complications
- Cardiac Resynchronization Therapy –Indication, Procedure and complications
- Radiofrequency ablation- Principles and Techniques of Catheter ablation of Supraventricular and Ventricular arrhythmias

Practical:

1. Cardiovascular laboratory technology during cardiac pacemaker procedure
2. Defibrillation set up and maintenance of QC of defibrillator
3. Laboratory procedures during radiofrequency ablation techniques

Textbooks recommended: (Latest edition)

1. Braunwald's Textbook of Cardiovascular Medicine
2. Manual of Cardiovascular Medicine-Brian Griffith
3. Hurst's The Heart
4. BLS and ACLS Guidelines (American heart Association Guidelines)

Paper III: Interventional cardiology and cardiac intensive care**Theory:**

- Angioplasty: Percutaneous Coronary Angioplasty, Maintaining Perfusion with Angioplasty, Cutting Balloon angioplasty catheter.
- Stents-various types
- Valvuloplasty- Mitral, Pulmonary, Aortic- Principles and Indications, Techniques, Hardware requirement, Procedural Complications.
- Device Closures-Atrial Septal defects, Patent ductus arteriosus, Ventricular Septal defect, ruptured sinus of Valsalva and other shunt lesions. Principles and Indications, Techniques, Hardware requirement, Procedural Complications
- Endovascular interventions- Peripheral angioplasty (Lower limb, renal, subclavian, mesenteric and carotid stenting), Embolization treatment-Coils, particles and gel foam. Principles and Indications, Techniques, Hardware requirement, Procedural Complications
- Introduction to Cardiac Intensive Care- Principles, Common Disorders
- Approach to a patient with Cardiac Emergency, Commonly Used Cardiac drugs, dosage and side effects
- Management of Common cardiac Emergencies-Acute Myocardial Infarction, Acute Left ventricular failure, Pulmonary oedema, Pulseless Ventricular tachycardia, Ventricular fibrillation, cardiac Tamponade
- Principles and Techniques of Bedside Cardiac Procedures-Trans venous Pacing, Central Venous lines, Pericardiocentesis, IABP
- Cardiopulmonary Resuscitation: -
- Basic and Advanced Cardiac Life Support- Principles and Techniques

Practical:

1. Cardiovascular laboratory technology during cardiac interventions,
2. Techniques and Principles in Hardware Choices I Coronary Interventions
3. Balloon Preparation and sizing for Valvuloplasty
4. Quantitative Coronary Angiography for guiding angioplasty and Stenting
5. Angiographic measurement of defect sizes
6. Connection of Angiographic contrast injectors and performance of cavity angiography
7. Process the cine films
8. Identification of intra cardiac signals
9. Setting up of Intracardiac multichannel recordings for Electrophysiology studies
10. To assist in detecting abnormal intracardiac signals
11. Emergency care of Cardiac patients

12. Cardiac Resuscitation
13. Proper concentration on sterility
14. Maintaining a proper hospital record of the procedures

Textbooks recommended: (Latest edition)

1. Braunwald's Textbook of Cardiovascular Medicine
2. Manual of Cardiovascular Medicine-Brian Griffith
3. Hurst's The Heart
4. BLS and ACLS Guidelines (American heart Association Guidelines)

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. Write very short answers on the following:** 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. Write very short answers on the following:

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 cardiac laboratory technology & Biochemistry**

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. Write Essay about common cardiac emergency ailments. Name five emergency cardiac equipment

(5+5)

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

- a. Defibrillator
b. Cardiac rhythm
c. Bradycardia and Heart block
d. Echo machine
e. Blood pressure and cardiac output

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

- a. Mitral valve
b. Central venous pressure
c. Cardiac action potential
d. Venous sampling
e. Cardiac enzymes

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

- a. Describe in detail the sources, biochemical functions and deficiency manifestation of calcium.

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

- a. Explain the working principle of gel filtration chromatography.
b. Mention the biochemical tests for assessment of iron status and briefly describe them.
c. Describe the mechanisms of action of enzymes.
d. Describe the biochemical functions of Vitamin K.
e. What is basal metabolic rate and what is its significance?

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

- a. How is 1M of NaCl prepared?
b. What is Bohr effect?
c. Name and briefly describe a test to detect protein in urine.
d. Name any two richest sources of vitamin C and describe its role in the human body.
e. Describe various types of pipettes and their applications.

Model Question paper**Phase II- Paper I: Electrocardiogram including Holter recording**

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 describe conduction system of heart with a diagram. Write a note on various types of conduction blocks.

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

- a. Indication for Holter monitoring
- b. Electrical axis determination by ECG
- c. VT and ECG diagnosis
- d. Equipment required for complete Holter study and reporting
- e. Holter monitor and Loop recorder

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

- a. Unipolar lead
- b. QT interval
- c. Atrial fibrillation
- d. Calculation of heart rate
- e. Narrow QRS tachycardia

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

- a. Indication, patient preparation and connection in Holter monitoring. Describe the roll of Holter monitoring in patient with non-ischemic heart disease

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

- a. ECG lead positioning
- b. Holter ECG interpretation
- c. Different types of ambulatory ECG monitoring
- d. Einthoven's triangle
- e. Electrode position for precordial lead

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

- a. ST elevation
- b. Disadvantage of 24 hours ECG monitoring
- c. ECG features of LA enlargement
- d. PR interval
- e. Brugada Syndrome

Model Question paper**Phase II- Paper II: Cardiac Physiology, stress testing and stress echocardiography**

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. Indication, patient preparation and protocol of exercise stress testing. Describe echocardiographic features of strongly positive treadmill test

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

- a. Exercise testing equipment
- b. Cardiac cycle
- c. Contra indication to exercise testing
- d. SPECT protocol
- e. Viability testing

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

- a. Complications of exercise testing
- b. Cardiac calcium score
- c. Stunning
- d. Thallium scan
- e. Post exercise recovery

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

- a. Describe the procedure indication and complication of stress echo.

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

- a. Cardiac preload
- b. Duke treadmill score
- c. Isovolumetric contraction time
- d. Electrode position for precordial lead
- e. Different protocol available for exercise testing

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

- a. Formula for prediction of maximum heart rate
- b. FDG and gadolinium
- c. Laplace's law
- d. Modify Bruce protocol
- e. Late enhancement in MRI

Model Question paper**Phase II- Paper III: Echocardiography**

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 transthoracic echo views. Write a note on 17 segment model.

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

- a. Transoesophageal echo (TEE) procedure
- b. Principles of ultrasound
- c. Assessment of left ventricular diastolic function
- d. Congenital anomalies in echo
- e. Contrast echo

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

- a. Piezoelectric crystals
- b. TEE for ASD
- c. Pericardial effusion and tamponade
- d. Restrictive pericarditis
- e. M-mode

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

- a. Indication, patient preparation and complication of transoesophageal echo

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

- a. Methods to calculate ejection fraction
- b. TEE views
- c. Paediatric echo
- d. Assessment of aortic regurgitation and aortic stenosis
- e. Wall motion score index

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

- a. LV pressure assessment in echo lab-E/E'
- b. TEE in Cath lab
- c. Sterilization and maintenance of echo probe
- d. Portable echo
- e. Aliasing and Nyquist limit.

Model Question paper**Phase III - Paper I: Angiography and Haemodynamics**

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. Briefly explain the angiographic projections and storage of cine images for diagnostic angiogram

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

- a. Radiation side effects
- b. Oximetry and stepup
- c. Pressure injectors
- d. Aortography
- e. CO calculation

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

- a. DICOM images
- b. Zeroing of transducers
- c. Qp/Qs
- d. Seldinger technique
- e. PIGTAIL catheter

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

- a. Describe cardiac catheterization protocol for shunt lesions. How will you calculate pulmonary blood flow and vascular resistance?

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

- a. Radiation protection
- b. Pressure transducers and artifacts
- c. Ventriculography
- d. Digital subtraction angiography
- e. Universal precautions

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

- a. Collimators
- b. Gorlins formula
- c. TPI
- d. Guiding and diagnostic catheters
- e. Flat panel Cath lab.

Model Question paper**Phase III - Paper II: Pacemakers and Cardiac Electrophysiology**

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. Briefly explain indications, patient preparation, vascular access and procedure of dual chamber permanent pacemaker implantation.

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

- a. Arrhythmia entrainment
- b. Complication of permanent pacemaker implantation
- c. Automated external defibrillator
- d. VT ablation
- e. Indications of ICD

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

- a. Pacemaker nomenclature codes. Explain with example
- b. AH jump
- c. WPW syndrome
- d. Sites of RV pacing
- e. Synchronized shock

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

- a. Describe the basic EP protocol for the SVT. Draw a diagram of catheter placement during a basic EP study.

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

- a. Pacemaker programming
- b. 3D mapping
- c. Leadless pacemaker
- d. CS decapolar catheter
- e. Draw and label His bundle electrogram

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

- a. Overdrive pacing
- b. Cephalic vein cut down
- c. Isoproterenol injection
- d. Pacemaker sensitivity
- e. Extrastimulus pacing

Model Question paper**Phase III - Paper II: Interventional Cardiology and Cardiac Intensive care**

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. Indication, procedure, and advantages of primary percutaneous coronary intervention (PCI). Describe facilitated and rescue PCI

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

- a. Management of pulseless VT
- b. ASD device closure
- c. CPR
- d. ETCO₂ monitoring
- e. Central venous pressure monitoring

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

- a. Tornus catheter
- b. BMV hardware
- c. Optimal stent expansion
- d. LV assist devices
- e. Complications of PCI

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

- a. Describes the principles of managing a patient with acute myocardial infarction

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

- a. Bifurcation stenting
- b. Classification of Lesions
- c. IABP
- d. Types of stents and ISR
- e. Basic life support

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

- a. NC balloon
- b. Air embolism
- c. PCWP
- d. Pericardiocentesis
- e. Thrombolytic agents
