MALLA REDDY VISHWAVIDYAPEETH
(Deemed to be University)

MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED HEALTH CARE SCIENCES AND TECHNOLOGY

Suraram X Roads, Jeedimetla,
Hyderabad-500055
Web: https://mrvv.edu.in/

Program

Master of Science (M.Sc.)

Cardiovascular Technology (Cath Lab)

2026

MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED HEALTH CARE SCIENCES AND TECHNOLOGY

MASTER OF CARDIOVASCULAR TECHNOLOGY (CATH LAB)

VISION

To develop highly skilled cardiovascular technologists who contribute to quality patient care through advanced clinical practice, research, and innovation in cardiac sciences.

MISSION

- To provide advanced knowledge and hands-on training in cardiovascular technology and cath lab procedures
- To promote ethical clinical practice and patient safety
- To enhance research skills and evidence-based practice
- To prepare students for multidisciplinary teamwork in cardiac care

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates will:

- Apply cardiovascular technology knowledge in clinical practice
- Assist and perform diagnostic and interventional cardiac procedures
- Participate in clinical research and innovation
- Practice ethically and professionally in healthcare settings
- Contribute to improving cardiovascular health in society

PROGRAM OUTCOMES (POs)

Students will:

- Understand advanced cardiovascular concepts
- Assist in diagnostic and interventional procedures in cath lab
- Analyze ECG, imaging, and hemodynamic data
- Follow safety protocols including radiation and infection control
- Communicate effectively with healthcare teams
- Apply ethical principles in patient care
- Use modern medical equipment and technologies
- Manage emergency situations in cardiac settings
- Engage in lifelong learning and skill development

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students can:

- Assist in cardiac catheterization and interventional procedures
- Interpret ECG, angiography, and imaging findings
- Handle cath lab equipment and technologies efficiently

- Provide pre, intra, and post-procedure patient care
- Participate in clinical and research activities in cardiology

COURSE OUTCOMES (COs)

Students will:

- Understand cardiac anatomy, physiology, and diseases
- Interpret ECG and cardiovascular imaging
- Assist in interventional cardiology procedures
- Apply pharmacology knowledge in cardiac care
- Maintain patient safety and sterile techniques
- Develop clinical and technical skills in cath lab

MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED HEALTH CARE SCIENCES AND TECHNOLOGY

MASTER OF CARDIOVASCULAR TECHNOLOGY (CATH LAB)

COURSE STRUCTURE

I year I semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Research Methodology and Biostatistics	4	-	-	4	40	60	100
2		Cardiac Anatomy, Physiology and Pathology of Cardiac diseases	3	-	-	3	40	60	100
3		Introduction to Cath Lab & Interventional Cardiology	3	-	2	4	40	60	100
4		Basics of Medical and Surgical Treatments of Cardiac Diseases	2	-	-	2	40	60	100
5		Diagnostic Cardiovascular Imaging	2	-	-	2	40	60	100
6		Clinical Postings I	-	-	12	6	40	60	100
TOTAL			**14**	**-**	**12**	**21**	**240**	**360**	**600**

I year II semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Advanced Electrocardiogram	3	-	2	4	40	60	100
2		Applied Pharmacology	3	-	-	3	40	60	100
3		Cath and Intervention in Ischemic / Valvular Heart Disease	3	-	2	4	40	60	100
4		Electrophysiology And cardiac Pacemakers	3	-	2	4	40	60	100
5		Clinical Postings II	-	-	16	8	40	60	100
TOTAL			**12**	**-**	**22**	**23**	**200**	**300**	**500**

II year III semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Innovations in Cath Lab	4	-	-	4	40	60	100
2		Cath and Intervention in myocardial, pericardial Disease & Non cardiac intervention	3	-	2	4	40	60	100
3		Cath and Intervention in Congenital Heart Diseases	3	-	2	4	40	60	100
4		Clinical Postings III	-	-	16	8	40	60	100
TOTAL			**10**	**-**	**20**	**20**	**160**	**240**	**400**

II year IV semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Thesis/Research Project	-	-	16	8	40	60	100
2		Quality Control in Cardiovascular Imaging	2	-	-	2	40	60	100
3		Entrepreneurship in Cardiovascular Technology	2	-	-	2	40	60	100
4		Clinical Postings – IV	-	-	16	8	40	60	100
TOTAL			**4**	**-**	**32**	**20**	**160**	**240**	**400**

Post Graduate Programme

Sl. No.	Course	Duration	Eligibility for admission
1	M.Sc. Cardiovascular Technology (Cath Lab)	2 years	He/she has passed the BSc in Cardiac Technology or equivalent examination of a recognized Indian University or a duly constituted Board with pass marks (50%).

1.2. Medium of Instruction:

English shall be the medium of instruction for all subjects of study and for examinations.

1.3. Duration of the Course

Duration details are mentioned under clause no. 1.1 of this booklet.

1.4 Examination Regulations

1.4.1 Attendance: 75% of attendance (physical presence) is mandatory.

Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the closing of attendance before the final examination.

1.4.2 Internal Assessments:

a) Regular periodic assessment shall be conducted throughout the course. In each semester there will be **two one-hour internal assessments (10 marks each)** and a continuous assessment (10 marks). Thus, a total of 30 marks for the internal exam. (i.e. weightage for internal assessment shall be 30% of the total marks in each subject).

b) **Exam pattern for internal assessment** in each semester will be

(a) Short questions 3 nos. out of which the student should write two questions each carrying 5 marks (i.e. 2 x 510 marks). Two such internal examinations will be conducted.

(b) Continuous assessment of the student will be done. Students' overall attendance, performance in class, behaviour of the student, extra-curricular activities etc will be assessed. Continuous assessment carries 10 marks.

(d) Thus, a total of 30 marks for the internal examination. (10+10+10=30 marks). A candidate should secure a minimum of 40% marks in the internal assessment in each subject to be eligible to appear for the University examination

(e) For value added courses, only internal examination will be conducted. The assessment comprised of five assignments/presentations/case presentations each carrying 10 (i.e. 5 x 10 = 50 marks). Final examination will be for 50 marks with 5 questions each carrying 10 marks (5 x 10 = 50 marks). The minimum pass is 40% marks.

1.4.3 University Examinations (External):

a) University Examination shall be conducted at the end of every semester.

b) A candidate who satisfies the requirement of attendance and internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.

c) Examination will be of 3 hours duration (for theory). The question pattern for those subjects without practical examination (70 marks) will be (a) Three essay questions out of which the student should answer 2 questions each carrying 10 marks (i.e. 2 x 10 = 20 marks) (b) Eight short note questions out of which the student should attempt six questions, each carrying 5 marks (6 x 5 = 30 marks). (c) Ten very short questions each carrying 2 marks (i.e. 10 x 2 = 20 marks). Thus, a total of 70 marks.

d) The question pattern for practical examination (a) Spotters/major practical/minor practical/Viva/practical record.

The minimum pass for internal assessment is 40% and for the University Examination is 50%. i.e. a student should score a total of 50% (adding the internal and external examination) to pass in each subject.

SEMESTER I

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Research Methodology and Biostatistics	4	-	-	4	40	60	100
2		Cardiac Anatomy, Physiology and Pathology of Cardiac diseases	3	-	-	3	40	60	100
3		Introduction to Cath Lab & Interventional Cardiology	3	-	2	4	40	60	100
4		Basics of Medical and Surgical Treatments of Cardiac Diseases	2	-	-	2	40	60	100
5		Diagnostic Cardiovascular Imaging	2	-	-	2	40	60	100
6		Clinical Postings I	-	-	12	6	40	60	100
TOTAL			14	-	12	21	240	360	600

RESEARCH METHODOLOGY AND BIOSTATISTICS **(60 Hours)**

L/T/P/C

4/-/-/4

Learning Objectives

1. To understand the fundamentals and importance of research in scientific and healthcare fields.
2. To familiarize students with different types of research designs (qualitative, quantitative, experimental, observational).
3. To develop skills in formulating research problems, hypotheses, and objectives.
4. To understand methods of data collection, sampling techniques, and measurement tools.
5. To introduce basic statistical concepts used in research analysis.
6. To learn ethical principles and guidelines in conducting research.
7. To develop the ability to critically evaluate research articles and literature.
8. To gain knowledge on research proposal writing and report preparation.

Learning Outcomes

1. Explain key concepts and principles of research methodology.
2. Design a basic research study, including formulating research questions and hypotheses.
3. Select appropriate research designs and sampling techniques for different studies.
4. Collect, organize, and analyze data using suitable statistical tools.
5. Interpret research findings and draw meaningful conclusions.
6. Apply ethical standards in research involving human subjects.
7. Critically appraise published research papers.
8. Prepare and present a structured research proposal or project report.

RESEARCH METHODOLOGY **(**30 hours)

Introduction to research; Types of research; Defining a research question; Qualitative study designs; Quantitative study; Type I and type II bias; Study design: types

Case study, Case series, longitudinal cohort, Pre post design, Time series design, repeated measures design, Randomized control design.

Sampling design, calculating minimum sample size based on design

Measurement: Properties of measurement: reliability, validity, responsiveness,

MCID. Outcome measures: Use of outcome measures in rehabilitation research

Research Methods: Designing methodology, Reporting results, Type I and Type II bias. Communicating research.

Evaluating published research: looking at the evidence

Introduction to evidence-based practice, evaluating evidence Asking clinical questions

Translating of evidence into practice: strategies

Use of clinical practice guidelines, clinical pathways, prediction rules to inform practice. BIOSTATISTICS

(30 hours)

Descriptive Statistics and measurement variability; Inferential Statistics; Comparison of group means: T test; Analysis of variance; Multiple comparison tests
Parametric and non-parametric tests
Correlations
Regression
Analysis of frequencies: Chi square
Statistical measure of validity and reliability Factorial Design analysis
Power analysis – Determining sample size, Epidemiological Measures–Rate, Ratio, Proportion, Incidence and prevalence, Relative risk, Risk ratio, Odds ratio
Application of various statistical software.

RECOMMENDED TEXT BOOKS

1. Statistical methods in Biology by Bailey, N.T.J

2. Statistical methods by Gupta, S.P

3. Research Methodology by Kumar, R

CARDIAC ANATOMY, PHYSIOLOGY AND PATHOLOGY OF CARDIAC DISEASES

(45 Hours)

L/T/P/C

3/-/-/3

Learning Objectives

- To understand the detailed anatomy of the heart, including chambers, valves, and major vessels.
- To explain the physiological mechanisms of cardiac function, including cardiac cycle and conduction system.
- To understand coronary circulation and its clinical significance.
- To learn the fundamentals of hemodynamics and blood flow regulation.
- To identify common cardiac diseases and their underlying pathophysiology.
- To understand risk factors and progression of cardiovascular diseases.
- To correlate anatomical and physiological changes with clinical conditions.
- To develop a foundation for interpreting diagnostic procedures in cardiology.

Learning Outcomes

- Describe the normal anatomy and structure of the heart and great vessels.
- Explain cardiac physiology including electrical conduction and cardiac cycle.
- Interpret basic hemodynamic parameters and their clinical relevance.
- Identify and explain the pathophysiology of common cardiac diseases such as coronary artery disease, heart failure, and valvular disorders.
- Correlate clinical symptoms with underlying cardiac abnormalities.
- Analyze risk factors contributing to cardiovascular diseases.
- Apply knowledge in understanding diagnostic tools like ECG, echocardiography, and angiography.
- Demonstrate critical thinking in linking theory to clinical cardiac conditions.

UNIT 1 ANATOMY OF HEART AND GREAT VESSELS (9hours)

- Anatomy and its subdivisions
- Blood and nerve supply of the heart
- Great vessels of the heart
- Structure of pericardium
- Structure of Aorta
- Venous drainage
- Aortic branches and vasculature
- Coronary arteries and veins

UNIT 2 CARDIAC CYCLE (9hours)

- Cardiac Cycle
- Conduction system of the heart
- Cardiac output and factors affecting cardiac output
- Sympathetic and Para Sympathetic innervations
- Systemic Circulation and Pulmonary Circulation
- Systemic hypertension and Pulmonary Hypertension

- Diastole, Ventricular filling and atrial diastole

UNIT 3 DISEASES OF CORONARY ARTERIES, HEART FAILURE (9hours)

- CAD and its types
- Causes, pathology and prevention of coronary artery diseases
- Symptoms and management of coronary artery disease
- Heart failure, Pathophysiology of Heart failure
- Heart failure medical management
- Heart failure surgical management
- Rheumatic Fever, Pathophysiology of Heart failure
- Coronary artery spasm and Angina

UNIT 4 HEART FAILURE AND RHEUMATIC FEVER (9hours)

- Disorders of valves, Valvular heart diseases
- Mitral valve diseases, its pathophysiology and its management
- Aortic valve diseases, its pathophysiology and its management
- Tricuspid valve diseases, its pathophysiology and its management
- Pulmonary valve diseases, its pathophysiology and its management
- Infective Endocarditis, Pathophysiology
- Management of Rheumatic fever
- Symptoms of Rheumatic fever

UNIT 5 CONGENITAL HEART DISEASES AND DISEASES OF MYOCARDIUM (9hours)

- Classification of Congenital heart diseases
- Diseases of Myocardium, Myocarditis, causes and management of myocarditis
- Pericarditis, causes and management of pericarditis
- Types of Cardiomyopathies, Pathophysiology and management
- Dilated Cardiomyopathy, Pathophysiology and management
- Hypertrophic Cardiomyopathy, Pathophysiology and management
- Diseases of the Pericardium
- Arrhythmogenic right ventricular cardiomyopathy

REFERENCE:

- The human heart by amar vasmani
- Cardiovascular Physiology by richard

INTRODUCTION TO CATH LAB AND INTERVENTIONAL CARDIOLOGY **(45 Hours)**

L/T/P/C

3/-/2/4

Learning Objectives (LOs)

To understand the basic concept and scope of **interventional cardiology**.

1. To familiarize with the design, layout, and workflow of a cardiac catheterization laboratory (Cath Lab).
2. To identify different equipment used in the Cath Lab (imaging systems, catheters, guidewires, contrast injectors).
3. To understand radiation safety principles and protection measures for patients and staff.
4. To learn aseptic techniques and infection control practices in the Cath Lab.
5. To understand the roles and responsibilities of Cath Lab personnel.
6. To gain basic knowledge of common diagnostic and interventional procedures (coronary angiography, angioplasty, stenting).
7. To understand patient preparation, monitoring, and post-procedure care.

Learning Outcomes

1. Describe the structure, function, and workflow of a Cath Lab.
2. Identify and handle basic Cath Lab equipment and instruments.
3. Explain the principles of interventional cardiology procedures.
4. Demonstrate knowledge of radiation safety and apply protective measures.
5. Follow standard aseptic and infection control protocols.
6. Assist in basic diagnostic and interventional procedures under supervision.
7. Monitor patients during procedures, including vital signs and ECG.
8. Explain pre-procedural and post-procedural patient care.
9. Recognize complications during procedures and report appropriately.

Basic Foundations **(**9 hrs)

Pathophysiology of common cardiovascular diseases (CAD, valvular disease, congenital heart disease)

Basics of vascular anatomy relevant to access (femoral, radial, brachial)

Diagnostic Catheterization (9 hrs)

Indications & contraindications for diagnostic catheterization
Catheterization equipment: catheters, guidewires, contrast agents, sheaths, introducers
Access techniques, vascular access complications
Hemodynamic monitoring: pressure curves, waveforms, cardiac output, shunts

Therapeutic / Interventional Procedures **(**9 hrs)

Percutaneous Coronary Interventions (PCI): angioplasty, stenting, different stent types (bare metal, DES), lesion assessment (calcification, bifurcation, chronic total occlusion)
Non-coronary interventions: valvuloplasty, device closure (ASD, VSD, PDA), structural heart interventions
Balloon angioplasty, rotational atherectomy, thrombus aspiration etc.

Imaging in Interventional Cardiology **(**9 hrs)

Fluoroscopy basics: physics, image acquisition, contrast, dose management
Angiography techniques: projections, views, interpreting angiograms
Adjunct imaging: Intravascular Ultrasound (IVUS), Optical Coherence Tomography (OCT), Fractional Flow Reserve (FFR)
Use of CT angiography in pre-planning

Patient care, Safety, and Supportive Technologies **(**9 hrs)

Pre- and post-procedure patient care: monitoring, sedation / anaesthesia, anticoagulation, anti-platelet therapy
Contrast media: types, reactions, kidney protection
Radiation safety: protection for patient / operator, ALARA principles
Infection control, sterile technique, procedural checklists
Emergency management: complications (bleeding, arrhythmias, perforation, no-reflow, etc.)

Ethical, Legal & Regulatory Issues (9 hrs)

Patient consent; risk-benefit discussions; documentation
Regulatory standards for Cath labs; equipment maintenance; accreditation
Ethical issues in interventional cardiology (device costs, patient selection, end-of-life etc.)
Quality assurance and audit in interventional practice

Emerging Trends & Innovations **(**9 hrs)

New devices, bioresorbable scaffolds, hybrid procedures
Structural heart interventions: TAVR, MitraClip, left atrial appendage occlusion etc.
Robotics, remote intervention, artificial intelligence in imaging & planning
Telemedicine / remote proctoring

PRACTICALS:

- Diagnostic Catheterization
- Therapeutic / Interventional Procedures
- Imaging in Interventional Cardiology

- Patient care, Safety, and Supportive Technologies
- Ethical, Legal & Regulatory Issues
- Emerging Trends & Innovations

Recommended Text Books

1. Interventional Cardiology: Principles and Practice by George D. Dangas, Carlo Di Mario, Nicholas N. Kipshidze, Peter Barlis, Tayo Addo, Patrick W. Serruys
2. Invasive Cardiology: A Manual for Cath Lab Personnel by Sandy Watson, Kenneth A. Gorski
3. Textbook of Catheter-Based Cardiovascular Interventions: A Knowledge-Based Approach by Peter Lanzer (editor) et al.

BASICS OF MEDICAL AND SURGICAL TREATMENTS OF CARDIAC DISEASES **(30 Hours)**

L/T/P/C

2/-/-/2

Learning Objectives

1. To understand the principles of medical management of common cardiac diseases.
2. To familiarize with commonly used cardiovascular drugs (antiplatelets, anticoagulants, beta-blockers, ACE inhibitors, statins, etc.).
3. To understand indications, mechanisms of action, and side effects of cardiac medications.
4. To learn the basic principles of surgical management in cardiac diseases.
5. To identify different types of cardiac surgeries (CABG, valve replacement, congenital defect repairs).
6. To understand indications and contraindications for medical vs surgical interventions.
7. To learn pre-operative and post-operative patient care in cardiac conditions.
8. To understand complications associated with medical and surgical treatments.

Learning Outcomes

1. Explain the basic principles of medical management in cardiac diseases.
2. Identify commonly used cardiovascular drugs and describe their actions and uses.
3. Differentiate between medical and surgical treatment approaches for various cardiac conditions.
4. Describe common cardiac surgical procedures such as CABG, valve surgeries, and device implantation.
5. Assist in the care of patients undergoing medical and surgical cardiac treatment.
6. Monitor patients for drug effects, side effects, and complications.
7. Explain pre-operative and post-operative management of cardiac patients.
8. Recognize complications and respond appropriately in a clinical setting.

UNIT 1 DIFFERENT TYPES OF SURGERY (6 hrs)

- Coronary artery bypass grafting (ON PUMP CABG)
- Uses, Procedure of CABG
- Post- operative care, results and complications of CABG
- Valvular heart disease and its types
- Mitral valve diseases and its surgical procedures
- Difference between the repair and replacement of valves
- Aortic valve diseases and its surgical procedures
- Tricuspid and pulmonary valve diseases and its surgical procedures
- CABG surgery and its complications
- Aortic aneurysm repair

UNIT 2 SURGERY IN CONGENITAL HEART DISEASE (6 hrs)

- Classification of congenital heart disease
- ASD closure / device / surgical
- Difference between device closure and surgical closure for CHD
- VSD closure / device / surgical

- TOF repair, uses, procedure and complications
- Glenn shunt procedure, uses and complications
- Fontan procedure, uses and complications
- Pulmonary artery banding procedure, uses and complications

UNIT 3 DISEASES OF AORTA AND THORACIC AORTA (6 hrs)

- Classification diseases of Aorta
- Types of aneurysms of aorta and its complications
- Standford classification
- DeBakey classification
- Procedure and surgery for aortic arch, management and their complications
- Procedure and surgery for ascending aorta, management and their complications
- Procedure and surgery for descending aorta, management and their complications
- Management and complications of diseases of aorta
- Marfan syndrome

UNIT 4 MANAGEMENT OF IHD/ VALVULAR / CONGENITAL HEART DISEASES (6 hrs)

- Ischemic heart disease, and their management and complications
- Invasive techniques used in ischemic heart diseases
- Coronary artery diseases and its complications
- Valvular heart disease, and their management and complications
- Procedure and surgery for mitral stenosis and mitral regurgitation and their complications, management
- Procedure and surgery for aortic stenosis and aortic regurgitation and their complications, management
- Procedure and surgery for tricuspid stenosis and tricuspid regurgitation and their complications, management
- Procedure and surgery for pulmonary stenosis and pulmonary regurgitation and their complications, management
- Procedure and surgery of IHD, CHD
- Revascularization procedures

UNIT 5 CONGENITAL HEART DISEASES (6 hrs)

- Management of ASD both in adult and pediatric patients
- Management of VSD both in adult and pediatric patients
- Management of PDA both in adult and pediatric patients
- Management of COA both in adult and pediatric patients
- Management of TGA both in adult and pediatric patients
- Management of DORV both in adult and pediatric patients
- Management of Hypoplastic left heart syndrome in pediatric patients
- Lifestyle modifications and emotional support and counselling for child with CHD

REFERENCE:

- Brounwakds heart diseases
- Cardiology: An illustrated textbook, kanuchatterjee, 2013 edition

DIAGNOSTIC CARDIOVASCULAR IMAGING **(30 Hours)**

L/T/P/C

2/-/-/2

Learning Objectives:

1. To understand the principles and physics of various cardiovascular imaging modalities.
2. To familiarize with imaging techniques such as ECG, Echocardiography, X-ray, CT, MRI, and Angiography.
3. To learn the indications, contraindications, and limitations of each imaging modality.
4. To understand the role of contrast agents in cardiovascular imaging.
5. To identify normal and abnormal cardiac structures in imaging studies.
6. To understand image acquisition, processing, and interpretation basics.
7. To learn radiation safety and patient protection in imaging procedures.
8. To correlate imaging findings with clinical conditions.

Learning Outcomes:

1. Explain the basic principles of different cardiovascular imaging techniques.
2. Identify commonly used imaging modalities and their clinical applications.
3. Interpret basic findings in ECG, echocardiography, and angiography.
4. Differentiate between normal and abnormal cardiovascular imaging findings.
5. Select appropriate imaging modalities based on clinical scenarios.
6. Demonstrate knowledge of contrast use and safety precautions.
7. Apply radiation safety principles during imaging procedures.
8. Assist in performing basic cardiovascular imaging procedures.
9. Correlate imaging findings with patient diagnosis and management.

INTRODUCTION: (6 hrs)

Cardiac Physiology & Anatomy: Cardiac cycle, ECG, heart structure, hemodynamics; ECG fundamentals and their correlation with imaging findings;
Overview of imaging modalities: strengths, weaknesses, clinical utility

IMAGING TECHNIQUES: (6 hrs)

Echocardiography (Transthoracic, Doppler, TEE, 3D/4D, Stress)
Basic image acquisition, Doppler physics, quantitative analysis
Advanced tools: strain imaging, contrast echo, artifact recognition

CT (COMPUTED TOMOGRAPHY) (6 hrs)

Coronary CT angiography protocols, dose metrics, interpretation of coronary artery disease
Radiation safety: CTDI, DLP, field-of-view impacts, dose-saving techniques

MRI (MAGNETIC RESONANCE IMAGING) (6 hrs)

Physics: gating, cine sequences (bSSFP), T1/T2 mapping, phase-contrast imaging
Applications: viability, cardiomyopathy, myocarditis, congenital heart disease, angiography

NUCLEAR IMAGING & PET/SPECT (6 hrs)

Myocardial perfusion assessments, tracer principles, hybrid imaging applications

Clinical Pathologies and imaging in: Congenital heart disease; ischemic heart disease; valvular disorders; cardiomyopathies; pericardial and aortic diseases; masses; arrhythmias; device-related imaging, transplants

IMAGING PHYSICS & POST-PROCESSING: CT/MRI physics, 3D reconstruction techniques (MPR, MIP, volume rendering) (3 hrs)

QUALITY & SAFETY: Radiation dose management, diagnostic accuracy, artifact avoidance (3hrs)

RECOMMENDED TEXT BOOKS

1. Case-Based Textbook of Echocardiography and Cardiac MRI- Editors: Anita Sadeghpour, Azin Alizadehasl, Anita M. Kelsey

2. Advanced Cardiac Imaging by Nieman, Gaemperli, Lancellotti, Plein

3. Cardiac Imaging in Clinical Practice- Editors: Dmitriy Kireyev & Judy Hung

CLINICAL POSTINGS I	L/T/P/C
	-/-/12/6

Students should be posted in,

- CATH LAB
- CARDIAC ICU

SEMESTER II

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Advanced Electrocardiogram	3	-	2	4	40	60	100
2		Applied Pharmacology	3	-	-	3	40	60	100
3		Cath and Intervention in Ischemic / Valvular Heart Disease	3	-	2	4	40	60	100
4		Electrophysiology And cardiac Pacemakers	3	-	2	4	40	60	100
5		Clinical Postings II	-	-	16	8	40	60	100
TOTAL			**12**	**-**	**22**	**23**	**200**	**300**	**500**

ADVANCED ELECTROCARDIOGRAM **(45 Hours)** L/T/P/C

3/-/2/4

Learning Objectives

Students will be able to:

- Interpret advanced ECG and cardiac rhythms
- Understand pharmacological management in cardiology
- Learn interventional procedures in ischemic and valvular diseases
- Gain knowledge in electrophysiology and pacemakers
- Enhance clinical exposure in cath lab

Learning Outcomes

Students will:

- Analyze ECG patterns and identify abnormalities
- Apply pharmacology in patient management
- Assist in PCI and valvular interventions
- Understand pacemaker functioning and electrophysiology procedures
- Perform clinical duties with improved confidence

UNIT 1 THE ABNORMAL ELECTROCARDIOGRAM (9 hrs)

- Electrocardiogram waves, intervals and segments
- Electrocardiogram waves and its abnormalities
- The importance of chamber enlargement identifying in the ECG
- Left atrial and right atrial enlargement identifying in the ECG
- Left ventricular and right ventricular enlargement identifying in the ECG
- ECG finding in myocardial infarction.
- localization of ischemia/ infarction based on ECG
- primary and secondary T wave change
- Non-infarction q wave

UNIT 2 HEART BLOCKS (9 hrs)

- Conduction system in heart
- Axis deviation
- ECG findings in 1st degree AV BLOCKS
- ECG findings in 2nd degree AV BLOCKS
- ECG findings in 3rd degree AV BLOCKS or complete heart block
- Management of complete heart block
- Left bundle branch block
- Right bundle branch block
- Fascicular blocks.
- WPW syndrome and sick sinus syndrome

UNIT 3 CARDIAC ARRHYTHMIAS (9 hrs)

- Introduction and classification of cardiac arrhythmias
- Normal sinus rhythm
- ECG findings in tachyarrhythmia, bradyarrhythmia's
- Premature beats
- Supraventricular tachycardia
- Ventricular tachycardia
- Indications of Holter monitoring in cardiac arrhythmias.
- Cardioversion and Defibrillator
- Management of cardiac arrhythmia
-

UNIT 4 ELECTROLYTE IMBALANCES IN ECG (9 hrs)

- Specific electrolyte imbalances and importance of ECG
- Causes and ECG findings in hypercalcemia
- Causes and ECG findings in hypocalcaemia
- Causes and ECG findings in hypokalemia
- Causes and ECG findings in hyperkalemia
- Causes and ECG findings in Hypermagnesemia
- Causes and ECG findings in hypomagnesemia
- Long QT syndrome
- ECG in digoxin toxicity
- ECG changes in pericardial diseases

UNIT 5 VALVULAR AND CONGENITAL HEART DISEASES IN ECG (9 hrs)

- Causes and ECG findings in mitral valve disease
- Causes and ECG findings in aortic valve disease
- Causes and ECG findings in tricuspid valve disease
- Causes and ECG findings in pulmonary valve disease
- Importance of ECG in congenital heart disease
- ECG finding in atrial septal defect
- ECG finding in ventricular septal defect
- ECG finding in TOF
- ECG findings TGA
- Arrhythmias in congenital heart disease

PRACTICAL

- The Abnormal Electrocardiogram
- Heart Blocks
- Cardiac Arrhythmias
- Electrolyte Imbalances in ECG
- Valvular and Congenital Heart diseases in ECG Holter Monitoring
- Lifestyle Modifications
- Medications And Cardioversion
- Implantable Devices

REFERENCE:

- Leo Schamroth introduction to Electrocardiography clamber Narasimhan, Johnson Francis, Leo Schamorth
- Marriott's Practical Electrocardiography – Galen S. Wagner, David G Strauss

APPLIED PHARMACOLOGY **(45 HOURS)**

L/T/P/C

3/-/-/3

Learning Objectives :

1. To understand the basic principles of pharmacology including pharmacokinetics and pharmacodynamics.
2. To learn the classification, mechanism of action, indications, and side effects of commonly used drugs.
3. To understand drugs acting on the cardiovascular system (antihypertensives, antianginals, antiarrhythmics, anticoagulants, thrombolytics, etc.).
4. To familiarize with dosage, routes of administration, and drug interactions.
5. To understand adverse drug reactions and their management.
6. To learn rational drug use and prescription principles.
7. To understand emergency drugs used in critical care and cardiac settings.
8. To gain knowledge about recent advances in pharmacotherapy.

Learning Outcomes :

1. Explain fundamental pharmacological principles and drug actions.
2. Classify drugs based on their therapeutic use and mechanism of action.
3. Identify commonly used cardiovascular drugs and describe their clinical applications.
4. Calculate and administer appropriate drug dosages safely (under supervision).
5. Recognize and manage adverse drug reactions.
6. Analyze drug interactions and their clinical implications.
7. Apply knowledge of pharmacology in patient care, especially in cardiac and critical care settings.
8. Assist in safe medication administration and monitoring of patients.

General Pharmacology Basics **(**9 hrs **)**

Definition, classification of drugs
Pharmacokinetics (absorption, distribution, metabolism, excretion)Pharmacodynamics (dose-response, receptor theory, agonists/antagonists) Routes of drug administration, bioavailability, half-life, volume of distribution Drug interaction basics (pharmacokinetic, pharmacodynamic)

Cardiovascular Pharmacology **(**9 hrs)

Anti-hypertensives: ACE inhibitors, ARBs, β-blockers, calcium channel blockers, diuretics, vasodilators
Anti-arrhythmics: classification, indications, mechanism (e.g. Vaughan Williams classification)
Anti-ischemic agents: nitrates, ranolazine, etc.
Lipid-lowering agents: statins, fibrates, PCSK9 inhibitors, etc.

Anti-platelet & anti-coagulants: aspirin, clopidogrel, newer agents (P2Y12 inhibitors), GP IIb/IIIa inhibitors, oral anticoagulants (warfarin, DOACs), heparins (UFH, LMWH)

Pharmacology in Interventional Procedures **(**9 hrs)

Sedation / analgesia: drugs used (local anaesthetics, moderate sedation, conscious sedation), safety
Contrast agents: types, reactions (allergic, nephropathy), prevention and management
Vasodilators during procedure: nitrates, adenosine etc.
Drugs used in thrombolysis / adjunctive therapy during percutaneous coronary intervention (PCI)
Anti-platelet therapy around stenting: loading dose, maintenance, duration, dual antiplatelet therapy (DAPT), specifics in DES vs BMS, in special populations

Drugs in Emergency Management within Cath Lab **(**9 hrs)

ACLS drugs: epinephrine, amiodarone, lidocaine, magnesium
Vasopressors & inotropes: e.g. dopamine, dobutamine, norepinephrine, milrinone.
Anti-shock medications; management of arrhythmias during interventions
Antagonists and antidotes: e.g. reversal of anticoagulants, managing overdose / toxicity

Safety, Regulation, Ethics in Pharmacology **(**9 hrs)

Adverse drug reactions, monitoring, reporting (pharmacovigilance)
Drug regulatory agencies, approvals, labeling, generic vs brand names
Drug storage, handling in hospital setting (sterility, expiry etc.)
Ethical issues in drug trials, off-label use, cost vs access
Patient counselling, informed consent regarding drugs

Recent Advances in Pharmacotherapy **(**9 hrs)

New anticoagulants / antiplatelets / lipid agents (e.g. PCSK9 inhibitors, RNA therapies etc.)
Novel drug-eluting stent coatings / local drug delivery systems
Drug-device combination products
Personalized medicine in cardiovascular pharmacotherapy: pharmacogenomics etc.

Recommended Text Books

Textbook of Interventional Cardiovascular Pharmacology by Nicolas Kipshidze, Jawad Fareed, Patrick W. Serruys, Jeff Moses

Pharmacotherapeutic Management of Cardiovascular Disease Complications: A Textbook for Medical Students by M.S. Umashankar, A. Bharath Kumar

CATH AND INTERVENTION IN ISCHEMIC / VALVULAR HEART DISEASE

(45 Hours)

L/T/P/C

3/-/2/4

Learning Objectives :

1. To understand the pathophysiology of **ischemic heart disease** and **valvular heart disease**.
2. To learn the indications and contraindications for cardiac catheterization procedures.
3. To understand coronary angiography and its role in diagnosing ischemic heart disease.
4. To familiarize with interventional procedures such as **PTCA (angioplasty), stenting**, and adjunctive techniques.
5. To understand hemodynamic assessment in valvular heart diseases.
6. To learn interventional procedures in valvular diseases (balloon valvotomy/valvuloplasty, TAVR basics).
7. To identify Cath Lab instruments used in coronary and valvular interventions (catheters, guidewires, balloons, stents).
8. To understand complications associated with interventional procedures and their management.
9. To learn patient preparation, intra-procedural monitoring, and post-procedural care.

Learning Outcomes :

1. Explain the clinical features and pathophysiology of ischemic and valvular heart diseases.
2. Interpret coronary angiography findings and identify lesions.
3. Describe step-by-step procedures of angioplasty and stent placement.
4. Assist in coronary and valvular interventional procedures under supervision.
5. Monitor hemodynamic parameters during catheterization procedures.
6. Identify and handle Cath Lab instruments used in interventions.
7. Recognize complications such as bleeding, arrhythmias, restenosis, and manage appropriately.
8. Explain pre- and post-procedure care for patients undergoing interventions.
9. Correlate clinical findings with catheterization and imaging results.

Basics **(**9 hrs)

Review of coronary anatomy, coronary pathophysiology (atherosclerosis, plaque rupture, chronic total occlusion)

Valvular anatomy & physiology (aortic, mitral, tricuspid, pulmonary), types of valvular disease: stenosis, regurgitation, mixed lesions, congenital vs acquired

Hemodynamics in valvular lesions: pressure gradients, orifice area, regurgitant volume etc.

Ischemia vs infarction physiology, collateral circulation

Diagnostic Catheterisation in IHD & Valve Disease **(** 9 hrs)

Coronary angiography: indications, projections, quantification of stenosis, anatomical variations, non-invasive vs invasive imaging modalities
Hemodynamic catheterization: left and right heart catheterization, measurement of pressures, gradients across valves, cardiac output (Fick / thermodilution), valve orifice calculation, assessment of pulmonary pressures in MR/TR etc.
Non-coronary imaging adjuncts: echocardiography, Doppler, TEE, CT angiography, MRI if relevant

Percutaneous Coronary Intervention (PCI) in Ischemic Heart Disease **(** 9 hrs)

Indications (stable angina, ACS, STEMI, NSTEMI), risk stratification, patient selection
Equipment: guidewires, balloons, stents (bare metal, drug-eluting), special devices (PTCA, drug-coated balloons, atherectomy, thrombus aspiration)
Technique: lesion preparation, wire strategy, bifurcation lesions, chronic total occlusion, calcified lesions, guidance by imaging / physiology (FFR, iFR)
Primary PCI: timing, adjunctive therapies
Post PCI pharmacotherapy, follow up, prevention of restenosis and stent thrombosis

Catheter-based Interventions in Valvular Heart Disease **(** 9 hrs)

Balloon valvuloplasty: mitral, aortic, pulmonary (in pediatric / adult) – indications, sizing, risks

Transcatheter valve replacement (TAVR / TAVI) for aortic stenosis/insufficiency: patient selection, valve types, access routes, procedural steps, imaging guidance, complications

Transcatheter mitral valve repair / replacement (including MitraClip etc.)

Percutaneous interventions for other valvular lesions: tricuspid interventions, pulmonary valve, etc.

Hybrid approaches vs surgical valve replacement: pros/cons, long-term outcomes

Complications & Their Management **(** 9 hrs)

Coronary perforation, dissection, no-reflow, distal embolization, acute closure, stent thrombosis
Valve-specific complications: paravalvular leak, valve malpositioning, prosthesis-patient mismatch, coronary obstruction in TAVR, heart block etc.
Access site complications, contrast nephropathy, stroke, bleeding, arrhythmias
Measures to prevent complications: anticoagulation, antiplatelet therapy, imaging guidance, adjunctive devices, patient monitoring

Patient Management Pre-, During, & Post-Intervention **(** 9 hrs)

Pre-procedure workup: labs, imaging, patient counseling, risk scoring (STS, EuroSCORE etc.), dual antiplatelet, anticoagulation, renal protection
Intra-procedure: sedation / anaesthesia, contrast use, radiation safety, monitoring, team roles
Post-procedure care: hemodynamic monitoring, antiplatelet / anticoagulation regimens, follow-up imaging, rehabilitation, managing ischemia / residual lesion, valve function follow up, prosthetic valve care

PRACTICAL

- Diagnostic Catheterisation in IHD & Valve Disease
- Percutaneous Coronary Intervention (PCI) in Ischemic heart disease
- Catheter-based Interventions in Valvular Heart Disease
- Complications & Their Management
- Patient Management Pre-, During, & Post-Intervention

Recommended Text Book

1. The Interventional Cardiac Catheterization Handbook by Morton J. Kern, Michael J. Lim, Paul Sorajja
2. The Interventional Cardiology Handbook Editors: Salvatore Brugaletta, Manel Sabaté

ELECTROPHYSIOLOGY AND CARDIAC PACEMAKERS **(45 Hours)**

L/T/P/C

3/-/2/4

Learning Objectives :

1. Understand the cardiac conduction system and basic electrophysiological principles.
2. Learn the mechanisms of cardiac arrhythmias and their classification.
3. Understand indications and techniques of electrophysiological (EP) studies.
4. Familiarize with mapping systems used in electrophysiology.
5. Learn the principles of temporary and permanent cardiac pacing.
6. Understand types of pacemakers (single chamber, dual chamber, biventricular/CRT).
7. Gain knowledge of implantable devices such as ICDs (Implantable Cardioverter Defibrillators).
8. Understand device indications, programming basics, and troubleshooting.
9. Learn complications and management related to EP procedures and device implantation.

Learning Outcomes:

1. Explain cardiac electrophysiology and conduction pathways.
2. Identify and classify common cardiac arrhythmias.
3. Interpret basic electrophysiological study findings.
4. Describe indications and procedures for pacemaker and ICD implantation.
5. Differentiate types of pacemakers and their clinical applications.
6. Assist in EP studies and device implantation procedures under supervision.
7. Monitor patients with pacemakers and detect device-related issues.
8. Recognize complications such as lead displacement, infection, and device malfunction.
9. Apply knowledge in patient care before and after EP and pacing procedures.

Cardiac Electrophysiology Fundamentals **(** 9 hrs)

Electrical conduction system of the heart Ion channels and action potentials
Electrocardiography (ECG) interpretation Mechanisms of arrhythmias
Electrophysiological properties of cardiac tissues

Arrhythmias and Their Mechanisms **(**9 hrs)

Supraventricular arrhythmias (e.g., atrial fibrillation, atrial flutter)

Ventricular arrhythmias (e.g., ventricular tachycardia, ventricular fibrillation)

Conduction disorders (e.g., AV block, bundle branch block)

Inherited arrhythmias and syndromes
Mechanisms of arrhythmia induction and termination

Electrophysiology Study (EPS) Techniques **(** 9 hrs)

Indications for EPS
Catheter placement and manipulation

Intra-cardiac recording techniques

Programmed stimulation and mapping techniques

Use of 2D and 3D mapping systems

Cardiac Pacemakers and Implantable Devices **(**9 hrs)

Indications for pacemaker implantation

Types of pacemakers (single-chamber, dual-chamber, biventricular)

Lead placement and fixation techniques

Pacemaker programming and troubleshooting

Implantable cardioverter-defibrillators (ICDs)

Advanced Topics in Electrophysiology **(**9 hrs)

Catheter ablation techniques (radiofrequency, cryoablation)

Conduction system pacing (His bundle pacing, left bundle branch area pacing)

Resynchronization therapy (CRT)

Lead extraction techniques

Emerging technologies in electrophysiology

PRACTICAL

- Cardiac Electrophysiology Fundamentals
- Arrhythmias and Their Mechanisms
- Electrophysiology Study (EPS) Techniques
- Cardiac Pacemakers and Implantable Devices
- Advanced Topics in Electrophysiology

Recommended Text Books

1. Clinical Cardiac Electrophysiology: Techniques and Interpretations by Mark E. Josephson

2. Cardiac Pacing and ICDs by Kenneth A. Ellenbogen, Mark A. Wood, and Jonathan L. Wilkoff

3. Electrophysiologic Disorders of the Heart by Douglas P. Zipes and Jose Jalife

4. Practical Electrophysiology by Peter W. Macfarlane

CLINICAL POSTINGS – II

L/T/P/C

-/-/16/8

Students should be posted in,

- CATH LAB

SEMESTER III

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Innovations in Cath Lab	4	-	-	4	40	60	100
2		Cath and Intervention in myocardial, pericardial Disease & Non cardiac intervention	3	-	2	4	40	60	100
3		Cath and Intervention in Congenital Heart Diseases	3	-	2	4	40	60	100
4		Clinical Postings III	-	-	16	8	40	60	100
TOTAL			**10**	**-**	**20**	**20**	**160**	**240**	**400**

INNOVATIONS IN CATH LAB (**60 Hours)**

L/T/P/C

4/-/-/4

Learning Objectives

Students will be able to:

- Understand recent innovations in cath lab technologies
- Learn interventions in myocardial, pericardial, and non-cardiac conditions
- Gain expertise in congenital heart disease interventions
- Strengthen advanced clinical skills

Learning Outcomes

Students will:

- Explain modern cath lab technologies and AI applications
- Assist in complex interventional procedures
- Manage congenital cardiac cases in cath lab
- Demonstrate advanced procedural and decision-making skills

Advancements in Catheterization Technologies **(** 12 hrs)

)Robotic-Assisted Procedures: Integration of robotic systems for precise catheter navigation and reduced operator fatigue.

Automated Catheter Tip Repositioning: Development of systems that allow for automated repositioning of catheter tips during procedures, enhancing imaging quality and procedural efficiency.

Active Lubrication Techniques: Implementation of ultrasonic vibrations to reduce friction during catheter insertion, minimizing tissue trauma and improving maneuverability.

Enhanced Imaging Modalities **(** 12 hrs)

Intravascular Imaging: Utilization of technologies like Optical Coherence Tomography (OCT) and Intravascular Ultrasound (IVUS) for detailed vessel wall assessment.

Fusion Imaging: Combining angiography with other imaging modalities (e.g., CT, MRI) to provide comprehensive anatomical and functional information.

Real-Time 3D Mapping: Adoption of three-dimensional mapping systems for accurate localization of catheter positions during interventions.

Minimally Invasive Techniques **(**12 hrs)

Transcatheter Valve Therapies: Advancements in procedures like Transcatheter Aortic Valve Replacement (TAVR) and MitraClip implantation.

Percutaneous Coronary Interventions (PCI): Innovations in stent design, drug-eluting technologies, and bioresorbable scaffolds.

Leadless Pacemakers: Development and implementation of leadless pacing systems to reduce complications associated with traditional pacemaker leads.

Integration of Artificial Intelligence (AI) and Machine Learning **(**12 hrs)

AI in Imaging Analysis: Application of AI algorithms to analyze imaging data for enhanced diagnostic accuracy.

Predictive Analytics: Use of machine learning models to predict patient outcomes and guide therapeutic decisions.

Automation in Procedure Planning: Development of AI-driven tools to assist in procedural planning and real-time decision-making.

Quality Control and Safety Protocols **(** 12 hrs)

Radiation Dose Management: Implementation of strategies to minimize radiation exposure to patients and healthcare providers.

Sterilization and Infection Control: Advancements in sterilization techniques and infection control measures in the cath lab environment.

Standardization of Procedures: Development of standardized protocols to ensure consistency and safety in cath lab operations.

Recommended Text Books

1. Cardiovascular Catheterization and Intervention by Debabrata Mukherjee, Eric R. Bates, Marco Roffi, Richard A. Lange, David J. Moliterno
2. Interventional Cardiology: Principles and Practice by Eric J. Topol
3. Manual of Interventional Cardiology by Eric J. Topol, Peter W. Armstro

CATH AND INTERVENTION IN MYOCARDIAL, PERICARDIAL DISEASE & NON - CARDIAC INTERVENTION (**45 Hours**)

L/T/P/C

3/-/2/4

Learning Objectives :

1. To understand the pathophysiology of **myocardial** and **pericardial diseases**.
2. To learn indications and techniques of cardiac catheterization in myocardial disorders (e.g., cardiomyopathies, myocarditis).
3. To understand diagnostic and therapeutic procedures for pericardial diseases (e.g., pericardiocentesis).
4. To familiarize with hemodynamic assessment in myocardial and pericardial conditions.
5. To learn interventional procedures such as **endomyocardial biopsy** and pericardial drainage.
6. To understand the role of imaging guidance in these interventions.
7. To gain knowledge about **non-cardiac vascular interventions** (peripheral angiography, angioplasty, embolization procedures).
8. To identify instruments and devices used in these procedures.
9. To understand complications and their management.
10. To learn patient preparation, intra-procedural monitoring, and post-procedural care.

Learning Outcomes :

1. Explain myocardial and pericardial disease processes and their clinical implications.
2. Describe catheter-based diagnostic and therapeutic procedures for these conditions.
3. Assist in procedures such as **pericardiocentesis** and **endomyocardial biopsy** under supervision.
4. Interpret basic hemodynamic and imaging findings related to myocardial and pericardial diseases.
5. Identify and handle Cath Lab instruments used in these interventions.
6. Assist in basic non-cardiac vascular interventions.
7. Monitor patients during and after procedures.
8. Recognize complications such as cardiac tamponade, arrhythmias, or vascular injury and respond appropriately.

9. Apply aseptic techniques and safety protocols in Cath Lab procedures.
10. Correlate clinical findings with procedural outcomes.

MYOCARDIAL DISEASES **(**15 hrs)

Ischemic Heart Disease: Pathophysiology, diagnostic approaches, and interventional strategies.

Non-Ischemic Cardiomyopathies: Dilated, hypertrophic, restrictive, and arrhythmogenic right ventricular cardiomyopathies.

Myocardial Infarction: Acute and chronic management, including percutaneous coronary interventions (PCI).

Myocardial Viability Assessment: Techniques such as dobutamine stress echocardiography and positron emission tomography (PET).

Pericardial Diseases **(**15 hrs)

Pericarditis: Etiology, clinical presentation, and management.

Pericardial Effusion and Tamponade: Diagnostic imaging, hemodynamic assessment, and pericardiocentesis techniques.

Constrictive Pericarditis: Pathophysiology, diagnostic challenges, and surgical interventions.

Non-Cardiac Interventions (15 hrs)

Renal Artery Interventions: Percutaneous transluminal renal angioplasty and stenting.

Pulmonary Artery Interventions: Management of pulmonary artery stenosis and interventions.

Vascular Access Techniques: Arterial and venous access for diagnostic and therapeutic procedures.

Endovenous Procedures: Laser and radiofrequency ablation for varicose veins.

PRACTICALS:

- Ischemic Heart Disease
- Non-Ischemic Cardiomyopathies
- Myocardial Infarction
- Myocardial Viability Assessment
- Pericarditis
- Pericardial Effusion and Tamponade
- Constrictive Pericarditis
- Non-Cardiac Interventions

Recommended Text Books

1. Cardiovascular Catheterization and Intervention: A Textbook of Coronary, Peripheral, and Structural Heart Disease by Debabrata Mukherjee, Eric R. Bates, Marco Roffi, Richard A. Lange, David J. Moliterno
2. Manual of Interventional Cardiology by Eric J. Topol, Peter W. Armstrong
3. Interventional Cardiology: Principles and Practice by Eric J. Topol

CATH AND INTERVENTION IN CONGENITAL HEART DISEASES **(45hours)**

L/T/P/C

3/-/2/4

Learning Objectives (LOs)

1. To understand the anatomy, classification, and pathophysiology of congenital heart diseases.
2. To learn indications and techniques of cardiac catheterization in congenital heart diseases.
3. To understand diagnostic and interventional procedures such as ASD, VSD, and PDA closures.
4. To familiarize with Cath Lab instruments, devices, and imaging used in congenital interventions.
5. To understand patient care, complications, and safety protocols in congenital procedures.

Learning Outcomes (COs / LBs)

1. Explain common congenital heart diseases and their hemodynamic significance.
2. Describe diagnostic and interventional catheterization procedures in congenital cases.
3. Assist in congenital cardiac interventions under supervision.
4. Identify and handle devices and instruments used in CHD interventions.
5. Recognize complications and provide appropriate patient care before and after procedures.

Anatomy and Physiology of Congenital Heart Defects

(9hrs)

Normal fetal and postnatal circulatory physiology

Embryology of common congenital heart defects

Hemodynamic consequences of congenital anomalies

Diagnostic Techniques in Congenital Heart Disease (9hrs)

Echocardiography: transthoracic and transesophageal approaches

Cardiac MRI and CT imaging

Cardiac catheterization: indications and procedural techniques

Hemodynamic assessment: pressure and oxygen saturation measurements

Interventional Procedures (9hrs)

Balloon atrial septostomy

Percutaneous closure of atrial septal defects (ASD) and patent foramen ovale (PFO)

Balloon valvuloplasty for pulmonary and aortic stenosis

Stent implantation for coarctation of the aorta

Transcatheter valve interventions

Device closure of ventricular septal defects (VSD)

Advanced Techniques and Technologies (9hrs)

Intravascular imaging: IVUS and OCT

Electrophysiological studies in congenital arrhythmias

Use of 3D mapping systems in complex congenital lesions

Emerging technologies: MRI-guided interventions and robotic-assisted procedures

Post-Procedure Care and Complications (9hrs)

Monitoring and management in the intensive care unit

Identification and management of complications: arrhythmias, embolism, bleeding

Long-term follow-up and surveillance strategies

Transitioning care from pediatric to adult cardiology

PRACTICALS:

- Anatomy and Physiology of Congenital Heart Defects
- Diagnostic Techniques in Congenital Heart Disease
- Interventional Procedures
- Advanced Techniques and Technologies
- Post-Procedure Care and Complications

Recommended Text Books

1. Cardiac Catheterization in Congenital Heart Disease by Neil Tailor, Ranjit Philip, and Shyam Sathanandam

2. Diagnostic and Interventional Catheterization in Congenital Heart Disease by David Gaze

3. Cardiovascular Catheterization and Intervention: A Textbook of Coronary, Peripheral, and Structural Heart Disease by Debabrata Mukherjee, Eric R. Bates, Marco Roffi, Richard A. Lange, David J. Moliterno

CLINICAL POSTINGS – III

L/T/P/C

-/-/16/8

Students should be posted in,

- CATH LAB

SEMESTER IV

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Thesis/Research Project	-	-	16	8	40	60	100
2		Quality Control in Cardiovascular Imaging	2	-	-	2	40	60	100
3		Entrepreneurship in Cardiovascular Technology	2	-	-	2	40	60	100
4		Clinical Postings – IV	-	-	16	8	40	60	100
TOTAL			**4**	**-**	**32**	**20**	**160**	**240**	**400**

THESIS/RESEARCH PROJECT L/T/P/C

-/-/16/8

Learning Objectives

Students will be able to:

- Conduct independent research and thesis work
- Understand quality control in cardiovascular imaging
- Learn basics of entrepreneurship in healthcare
- Gain complete hands-on clinical expertise

Learning Outcomes

Students will:

- Perform and present a research project scientifically
- Apply quality assurance and safety in imaging
- Understand business and innovation aspects in healthcare
- Independently assist and manage cath lab procedures
- Demonstrate professional competency in real-time clinical practice

In project/thesis, the students should be able to:

- Independently conduct research
- Critically analyze findings with scientific methodology

QUALITY CONTROL IN CARDIOVASCULAR IMAGING **(30 Hours)** L/T/P/C

2/-/-/2

Learning Objectives:

1. To understand the principles and importance of quality control (QC) in cardiovascular imaging.
2. To learn standard protocols and guidelines for maintaining imaging quality.
3. To understand calibration, maintenance, and performance testing of imaging equipment.
4. To familiarize with radiation safety, dose optimization, and patient protection measures.
5. To understand common imaging errors, artifacts, and methods to minimize them.

Learning Outcomes:

1. Explain the role and significance of quality control in cardiovascular imaging.
2. Apply standard QC protocols to ensure optimal image quality.
3. Identify and troubleshoot common imaging artifacts and errors.
4. Demonstrate knowledge of equipment maintenance and radiation safety practices.
5. Ensure patient safety and adherence to quality standards during imaging procedures.

Introduction to Quality Control (QC): Definitions, quality domains (AHA), rationale, regulatory standards (accreditation: ACR, IAC)

Imaging Process QC: Patient selection, standardized protocols, reporting consistency (5 hrs)

Modality-Specific QC – MRI: Protocol optimization, SNR/CNR metrics, QA programs (5 hrs)

Modality-Specific QC – CT: Radiation dose audits, dose reduction strategies, multidisciplinary oversight (5 hrs)

Modality-Specific QC – Echo: Reducing inter-observer variability, training interventions, EF measurement reproducibility (5 hrs)

Accreditation and QA Systems: Accreditation benefits, reporting standards, dose registries and benchmarking (5 hrs)

Automated QC Tools: AI in image quality prediction, automation in QC pipelines, integration in clinical workflow (5 hrs)

Case Studies & Implementation: Quality failure analyses, best practice examples, implementation roadmaps

RECOMMENDED TEXT BOOKS

1. Quality and Safety in Imaging - Editors: Lluís Donoso-Bach & Giles W. L. Boland

2. Echocardiography: The Normal Examination and Echocardiographic Measurements by

Bonita Anderson

ENTREPRENEURSHIP IN CARDIOVASCULAR TECHNOLOGY **(30 Hours)**

L/T/P/C

2/-/-/2

Learning Objectives (LOs)

1. To understand the basics of entrepreneurship and its relevance in cardiovascular technology.
2. To learn how to plan and manage healthcare-related ventures such as diagnostic centers or Cath Labs.
3. To understand financial management, budgeting, and resource allocation in healthcare settings.
4. To familiarize with legal, ethical, and regulatory requirements in healthcare businesses.
5. To develop leadership, communication, and decision-making skills for managing a healthcare enterprise.

Learning Outcomes (COs / LBs)

1. Explain the principles of entrepreneurship in the healthcare and cardiovascular domain.
2. Develop a basic business plan for a cardiovascular diagnostic or interventional setup.
3. Apply financial and managerial skills in running a healthcare facility.
4. Ensure compliance with legal, ethical, and regulatory standards.
5. Demonstrate leadership and problem-solving skills in healthcare management.

Introduction to Entrepreneurial Mindset: Role of entrepreneurship in healthcare; lean startup and business model canvas; specifics for cardiac tech innovation 6 hrs

Identifying Clinical Needs & Innovation: Unmet needs in cardiovascular care; stakeholder insight (clinicians, patients); case studies from devices like echo tools, AI imaging (6 hrs)

Business Modeling & Value Proposition: Value creation in CV tech; customer segmentation; designing offerings for cardiologists, imaging centers (6 hrs)

Intellectual Property & Regulatory Landscape: IP strategies, patenting in cardiac imaging devices; navigating ISO/GMP, CE, FDA pathways for cardiovascular technologies (6 hrs)

Financing and Market Development: Funding sources—grants, VC, angel; economic modeling for devices; reimbursement and health-economics in CV imaging (6 hrs)

Marketing, Strategy, & Scaling: Competitor mapping in CV imaging; go-to-market

options—hospitals, diagnostic centers; international expansion

Entrepreneurship Ethics & Policy: Ethical implications; equity in cardiovascular diagnostics; health policy dynamics affecting CV technology

RECOMMENDED TEXT BOOKS

1. Healthcare Entrepreneurship and Management: A Comprehensive Guide for Biomedical

Engineers and Entrepreneurs by Arnab Chanda & Shubham Gupta

2. Medical Entrepreneurship: Trends and Prospects in the Digital Age- Editors: Lukman

Raimi & Ibrahim Adekunle Oreagba

CLINICAL POSTINGS – IV	L/T/P/C
	-/-/16/8

- To provide supervised, hands-on clinical training in echocardiography and related cardiovascular imaging modalities.
- To enable students to apply theoretical knowledge in real-time patient care settings.
- To develop skills in advanced echocardiography techniques, interpretation, and reporting.
- The student should be able to independently perform, analyze, and report standard echocardiographic examinations, assist in advanced procedures, and integrate findings into patient management.