KHYBER MEDICAL UNIVERSITY

BS CARDIOLOGY AND CARDIAC PERFUSION TECHNOLOGY CURRICULUM

STUDY GUIDE SEMESTER 5

16 Weeks Activity Planner

2024-25

CENTRAL CURRICULUM & ASSESSMENT COMMITTE FOR NURSING, REHABILITATION SCIENCES & ALLIED HEALTH SCIENCES

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Paramedical Sciences Peshawar (IPMS-PESH) Mission:

To produce allied health professionals who are exceptional in their skills, research, compassionate treatment, and community involvement, thereby improving health care system.

Program Introduction

The BS Cardiology and Cardiac Perfusion program at Khyber Medical University is a comprehensive four-year undergraduate degree designed to equip students with the knowledge, skills, and competencies required to become competent Cardiology and Perfusion technologists. Cardiology and Cardiac Perfusion is a vital healthcare profession that focuses on the diagnosis, treatment, and management of cardiovascular diseases. Cardiac technologists work closely with patients, healthcare providers, and other medical professionals to provide accurate diagnoses and improve patient outcomes.

This Program is structured to provide students with a strong foundation in the sciences and specialized training in Cardiology and Cardiac Perfusion technology. Students will learn about the principles to introduce and impart standard technical education with new modern techniques, within the fields of cardiovascular technologies, by replacing the conventional methods of pre-service training (certificate level). To provide paramedical workers a status and recognition in the health care delivery system through improving their capacity along with increasing awareness of their responsibilities, authority and job description to equip allied health professionals with modern skills and latest technical knowledge and bring them as per with other national and international level.

Objectives

By the end of the BS Cardiology and Cardiac Perfusion Degree, the students will be able to:

Cognitive Domain:

1. Explain the principles of cardiovascular Anatomy, physiology, pathophysiology, and pharmacology, with emphasis on cardiac function, coronary circulation, and electrical activity of the heart.
2. Interpret pertinent clinical data to select appropriate diagnostic procedures, including echocardiography, stress testing, and invasive procedures for neonatal, pediatric, and adult patients.
3. Identify potential expanded roles for cardiac professionals by examining the history and professional behaviors within cardiology and cardiac technology.
4. Discuss the current professional and clinical roles of cardiac technologist, electrophysiology technologist, and echocardiography technologist, cardiac Perfusionist, ECMO specialist in healthcare settings.
5. Apply advanced knowledge of cardiology and related technologies to address current and future needs in clinical practice, patient care, education, research, and administration.

Psychomotor Domain:

1. Demonstrate proficiency in using the latest techniques and technologies in cardiac diagnostics and therapies, including interventional cardiology, electrophysiology, and echocardiography.
2. Perform clinical assessments and deliver high-quality diagnostics, including invasive procedures (e.g., catheterization) and non-invasive procedures (e.g., echocardiograms, EKGs), in a clinical environment.
3. Effectively communicate with patients, healthcare providers, and other medical professionals using appropriate medical terminology, ensuring clear and accurate exchange of information.
4. Work collaboratively with inter-professional healthcare teams to provide comprehensive, patient-centered care in the management of cardiovascular diseases.
5. Develop the skills necessary to work efficiently in a fast-paced healthcare environment, particularly in acute settings like cardiac catheterization labs and cardiac surgery units.

Affective Domain:

1. Exhibit professional behavior and adhere to ethical principles in all aspects of cardiology and cardiac technology, ensuring patient safety and confidentiality.
2. Incorporate evidence-based practices into patient care by identifying, accessing, and critically evaluating appropriate literature and medical research on cardiovascular diseases.
3. Demonstrate leadership and teamwork skills in the cardiology profession, including leading clinical teams, advocating for patients, and contributing to community health initiatives.
4. Engage in continuous learning and professional development, staying current with the latest advancements in cardiology, including interventions in electrophysiology, interventional cardiology, and cardiac perfusion technologies.
5. Provide compassionate, patient-centered care, ensuring that each patient's dignity, autonomy, and preferences are respected throughout diagnosis, treatment, and recovery.

Fifth semester subjects for BS Cardiology and Cardiac Perfusion Technology

S. No	Subjects	Duration
1	CAR-604 CLINICAL MEDICINE-I / CP- 601 CLINICAL MEDICINE 3(2+1)	16 weeks
2.	CAR-606 ECHOCARDIOGRAPHY – I / CP-603 ECHOCARDIOGRAPHY 3(2-1)	16 weeks
3.	CAR-607ELECTROCARDIOGRAPHY – II 3(2-1)	16 weeks
4..	CAR-609 MEDICAL PHYSICS 3(2-1) 3(2-1)	16 weeks
5.	CAR-605 ELECTROPHYSIOLOGY 3(2-1)	16 weeks
6.	CAR-608 INTERVENTIONAL CARDIOLOGY 3(2-1)	16 weeks
7.	CP-602 Perfusion Technology-I 3(2-1)	16 weeks
8.	CP-604 Ventricular Assistance Devices 3(2-1)	16 weeks

CAR-604 CLINICAL MEDICINE-I & CP-601 CLINICAL MEDICINE 3(2+1)

Course Description:

This course will provide basic and an in depth concepts of the common diseases affecting, CVS (acute coronary syndrome, heart failure, diseases of heart valves, cardiomyopathies, pericardial diseases, systemic hypertension and cardiac arrhythmias), Respiratory system: (Asthma, COPD), Renal system: (Acute & chronic Kidney failure, urinary tract infections, renal calculi, nephrotic syndrome and renal tumors), Endocrinology: (Pituitary gland disorders, thyroid disorders, parathyroid disorders, diabetes mellitus, adrenal gland diseases, gonadic disorders).

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Describe causes, risk factors, pathophysiology, clinical manifestations, investigative approaches, and management strategies of diseases of the cardiovascular system.
2. Discuss Pathophysiology of the specified Diseases in each System.
3. Explain Diagnostic approach and management strategies for specified Diseases in each System.
4. Interpret various tests and imaging findings to diagnose diseases.
5. Evaluate radiological studies (e.g., X-Ray, CT, MRI, angiography) to differentiate various heart problems through these tools.

Psychomotor Domain:

By the end of this course, students should be able to:

1. Perform a thorough general physical & systemic examination of CVS, respiratory, renal and endocrinology including inspection, palpation, percussion, and auscultation.
2. Interpret basic diagnostic tools like ECG, ETT, echocardiography, angiography reports, ultrasound, X-rays, Blood tests (cardiac biomarkers, RFTs', RBS, FBS & HbA1c).
3. Educate on **dietary modifications** for patients with heart failure, hypertension, renal stones, kidney injury, and diabetes mellitus.
4. Demonstrate the **examination & measurement of JVP** to assess heart failure.
5. Educate patients and families on prevention of hypertension & diabetes mellitus and long-term management strategies.

Affective Domain:

By the end of this course, students should be able to:

1. Comply with SOPs of practical & procedure effectively.
2. Acknowledge and validate the patient's pain and distress during consultations.
3. Demonstrate patience while taking a detailed history of symptoms.
4. Build trust by explaining the diagnostic process clearly.
5. Display understanding toward patients with anxiety about invasive procedures.
6. Demonstrate **ethical responsibility** by ensuring patient confidentiality and dignity in all interaction.

Table of Specification

CAR-610/CP- 601 Clinical Medicine-I 3(2+1)

S. No	Weeks	Contents	Learning Outcomes	Domain C	Domain P	Domain A	MIT's	Time/Hours	Assessment	No of Item
TOPIC: General Physical Examination & Systemic Examination of Cardiovascular System										
1	Week- 1	Introduction	Define history taking and its importance	C1			Interactive Lecture/SGD	2	MCQs	03
		Physical Examination	Explain Physical examination and Examination of CVS.	C2						
2		Investigations	Describe ECG, ETT, ECHO, Angiography, CXR, ABP, Holter's test, Cardiac CT 7 cardiac MR	C2						
3		Clinical features	Clinical features/Signs & Symptoms related to diseases of cardiovascular system	C3						
4		Practical	Practically perform all the steps involved in General Physical Examination & Systemic Examination of cardiovascular System. Examination & measurement of JVP		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	1
5		SOPs compliance	Adopt standard operating procedures (SOPs) for performing CVS examination and interpreting diagnostic tests			A4	Role Play			
TOPIC: Acute coronary syndrome										
6	Week- 2	Definition	Define ACS, causes and risk factors of stable & unstable angina, NSTEMI & STEMI	C1			Interactive Lecture/SGD	2	MCQs	05
7		Pathophysiology, Clinical features	Describe the Pathophysiology of ACS and Identify the clinical features and symptoms of ACS	C2						
8		Diagnosis & Investigations	Describe diagnostic approaches (clinical examination and Lab tests) performed to diagnose ACS	C3						
9		Treatment & Management	Discuss the pharmacological and surgical interventions of ACS including the latest algorithms.	C3						
10		Practical performance	Demonstrate the steps involved in the diagnosis of ACS including cardiac biomarkers, ECG and angiographic assessment through strips & reports		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
11		SOPs compliance	Adopt how to read different ECGs' of ACS			A4	Role Play			
TOPIC: Heart Failure										
12	Week- 3	Definition	Definition of various types of heart failure	C1			Interactive Lecture/SGD	2	MCQs	05
13		Causes and risk factors	Describe common causes and risk factors of HF	C2						
14		Pathophysiology, Clinical features	Explain the Pathophysiology of HF and identify clinical features of patients with various types of heart failures	C3						

15		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination and Lab tests). Discuss the pharmacological & surgical management of HF	C3						
16		Practical performance	Demonstrate the interpretation of basic findings from a CXR, lab tests, echocardiography, & JVP assessment		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
17		SOPs compliance	Demonstrate proper handling, organization, and care of a patient admitted for treatment/management of HF patient			A4	Role Play			
TOPIC: Diseases of heart valves										
18	Week- 4	Definition	Introduction to the diseases affecting valves of the heart	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
19		Causes and risk factors	Describe common causes and risk factors MS/MR & AS/AR.	C2						
20		Pathophysiology, Clinical features	Explain the Pathophysiology MS/MR & AS/AR. Identify the clinical features of MS/MR & AS/AR.	C3						
21		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination including murmurs and echocardiography and other tests).	C3						
		Management	Discuss the pharmacological and surgical interventions for the diseases involving heart valves							
22		Practical performance	Demonstrate the skills needed to evaluate patients having various diseases of heart valves through physical examination; pulse & murmurs		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
23		Practical performance	Adopt standard operating procedures (SOPs) for performing precordial examination and interpreting echocardiographic reports			A4	Role Play			
TOPIC: Diseases of heart valves, Endocarditis										
24	Week- 5	Introduction	Introduction to the diseases affecting valves of the heart	C1			Interactive Lecture/SGD	2	MCQs/SEQs	03
25		Causes and risk factors	Describe common causes and risk factors PS/PR, TS/TR and endocarditis	C2						
26		Pathophysiology, Clinical features	Explain the Pathophysiology PS/PR, TS/TR and endocarditis. Identify the clinical features of PS/PR, TS/TR and endocarditis	C3						
27		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination including murmurs and echocardiography and other tests).	C3						
			Discuss the pharmacological and surgical interventions for the diseases involving heart valves	C3						
28		Practical performance	Demonstrate the skills needed to evaluate patients having various diseases of heart valves through physical examination; pulse & murmurs		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2

29		SOPs compliance	Adopt standard operating procedures (SOPs) for performing precordial examination and interpreting echocardiographic reports			A4	Role Play			
TOPIC: Cardiomyopathies										
30	Week- 6	Introduction	Introduction to various types of cardiomyopathies	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
31		Causes and risk factors	Describe common causes and risk factors of cardiomyopathies	C2						
32		Pathophysiology, Clinical features	Explain the Pathophysiology of cardiomyopathies and identify the clinical features and symptoms of cardiomyopathies	C3						
33		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination and echocardiographic reports) Discuss the pharmacological and surgical treatment strategies for managing cardiomyopathies	C4						
34		Practical performance	Demonstrate skills of performing echocardiographic assessment of cardiomyopathies and relating the findings with clinical features of the patients		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
35		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examinations and interpreting findings related to cardiomyopathies			A4	Role Play			
TOPIC: Systemic Hypertension & Pericardial Diseases										
36	Week- 7	Introduction	Introduction to hypertension & pericardial diseases	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
37		Causes and risk factors	Describe common causes and risk factors for hypertension, pericarditis and pericardial effusion	C2						
38		Pathophysiology, Clinical features	Explain the Pathophysiology of hypertension, pericardial effusion and Identify the clinical features of pericardial diseases	C3						
39		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination CXR, Echo reports).	C3						
			Discuss the pharmacological and non- pharmacological treatments of managing hypertension, pericarditis, and pericardial effusion	C3						
		Practical performance	Demonstrate physical examination of a patient suspected for resistant hypertension.		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	1
39		SOPs compliance	Comply Standard Operating Procedures (SOPs) for Examination of patient with chest pain differentiating pain originating of ACS from that of pericarditis			A4	Role Play			
TOPIC: Cardiac Arrhythmias										
40	Week- 8	Introduction	Introduction to various types of atrial, junctional and ventricular arrhythmias	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
41		Causes and risk factors	Describe common causes and risk factors for various types of cardiac arrhythmias	C2						

42		Pathophysiology, Clinical features	Explain the Pathophysiology of AF, AFL, VT/VF & Identify the clinical features of various types of arrhythmias	C3						
43		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination ECG, Holter's test reports and EP studies). Discuss the pharmacological and electrophysiological interventions of managing arrhythmias	C3						
44		Practical performance	Demonstrate how to assess signs of cardiac arrhythmias including pulse assessment, ECG strips reading and relating these with clinical features		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	3
45		SOPs compliance	Adopt how to administer physical maneuvers to stabilize heart rate and rhythm			A4	Role Play			
TOPIC: Examination, Investigations of respiratory diseases										
46	Week- 9	Introduction	Introduction to examination of respiratory diseases	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
47		Causes and risk factors	Describe common causes and risk factors for various types of respiratory diseases	C2						
48		Investigations & clinical features	Explain the indications of various types of investigations including CXR, Spirometry, bronchoscopy, lab tests CT scan & Identify the clinical features of different types of respiratory problems	C3						
49		Treatment and prevention	Discuss the pharmacological and non- pharmacological treatments and summarize preventive strategies for respiratory problems	C3						
50		Practical performance	Demonstrate the clinical management of a patient with TB, Pneumonia, Asthma and lung cancers		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
51		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examinations and interpreting findings related to respiratory problems			A4	Role Play			
TOPIC: Asthma & COPD										
52	Week- 10	Introduction	Introduction to Asthma & COPD	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
54		Causes and risk factors	Describe common causes and risk factors of Asthma & COPD	C3						
55		Pathophysiology, Clinical features	Explain the Pathophysiology of Asthma & COPD and Identify the clinical features and symptoms	C3						
56		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination and Lab tests; CXR, spirometry, bronchoscopy).	C3						
			Discuss the pharmacological and non- pharmacological Treatments and Summarize preventive strategies	C3						

57		Practical performance	Demonstrate clinical examination techniques for asthma, focusing on clinical assessment, and diagnostic test interpretation.		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
58		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examination and interpreting findings related to Asthma/COPD			A4	Role Play			
TOPIC: Examination & Investigations of Renal system										
59	Week- 11	Definition	Introduction to renal diseases	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05
60		Causes and risk factors	Describe common causes and risk factors for various types of renal diseases	C2						
61		Pathophysiology, Clinical features	Explain the Pathophysiology of renal diseases and identify the clinical features associated with renal diseases.	C1						
62		Investigations & Diagnosis	Explain diagnostic approaches (clinical examination and Lab tests for renal diseases).	C2						
			Discuss RFTs', Urine examination, X-rays and ultrasounds, CT scans, MRI and other imaging tests	C3						
63		Practical performance	Demonstrate clinical examination techniques for assessing patients with renal diseases		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	1
64		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examination and interpreting RFTs', U/S, CT scans & MRI			A4	Role Play			
TOPIC: Renal Failure										
65	Week- 12	Introduction	Introduction to acute and chronic renal failure	C1			Interactive Lecture/SGD	2	MCQs/SEQs	03
66		Causes and risk factors	Describe common causes and risk factors for renal failure both acute and chronic	C2						
67		Pathophysiology, Clinical features	Explain the Pathophysiology of renal failure and identify the clinical features	C3						
68		Diagnosis, treatment	Explain diagnostic approaches (clinical examination and Lab tests).	C3						
			Discuss the pharmacological and non- pharmacological treatments	C3						
69		Practical performance	Demonstrate interpretation of the Ultrasound, RFTs, Serum electrolytes and ABGs'		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
70		SOPs compliance	Comply SOPs for Interpretation of Blood tests and Radiological tests for renal failure			A4	Role Play			
TOPIC: Urinary Tract Infections, Urinary obstruction & Renal stones										
71	Week- 13	Definition	Introduction to UTIs' & Renal calculi-urinary obstruction	C1			Interactive Lecture/SGD	2	MCQs/SEQs	05

72		Causes and risk factors	Describe common causes and risk factors for UTI and renal stone formation	C1						
73		Pathophysiology, Clinical features	Explain the Pathophysiology of renal calculi and Identify the clinical features and symptoms of UTI, renal stones and urinary obstruction	C2						
74		Diagnosis, treatment and prevention	Explain diagnostic approaches (RFTs', Urinary examination, Ultrasonography and other blood investigations).	C3						
75			Discuss the pharmacological and non- pharmacological treatments And summarize preventive strategies for UTIs' and renal stones	C4						
76		Practical performance	Demonstrate the skills in analyzing urine R/E, ultrasound studies and clinical examination of a patient with dysuria, and severe flank pain		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
77		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examinations and interpreting findings related to UTI and renal stone			A4	Role Play			
TOPIC: Nephrotic syndrome & renal tumors										
78	Week- 14	Introduction	Introduction to nephrotic syndrome and renal tumors	C1			Interactive Lecture/SGD	2	MCQs/SEQs	03
79		Classification	Explain classification of different renal tumors	C2						
80		Causes and risk factors	Describe common causes and risk factors for renal tumors	C3						
81		Pathophysiology, Clinical features	Explain the Pathophysiology of nephrotic syndrome and renal tumors and Identify the clinical features	C4						
82		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination and Lab tests). Discuss the pharmacological and surgical treatments strategies							
83		Practical performance	Demonstration of skills for assessing patients with renal tumors		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	1
84		SOPs compliance	Comply SOPs for transferring patients who are advised to get renal dialysis			A4	Role Play			
TOPIC: Endocrinology										
85	Week- 15	Introduction	Introduction to endocrinology	C1			Interactive Lecture/SGD	2	MCQs/SEQs	04
86		Classification	Explain classification of different types of endocrine disorders	C2						
87		Causes and risk factors	Describe common causes and risk factors for pituitary, thyroid, and parathyroid diseases	C3						

88		Pathophysiology, Clinical features	Explain the pathophysiology of pituitary, thyroid and parathyroid disorders, and identify the clinical features	C3						
89		Diagnosis, treatment and prevention	Explain clinical examination & diagnostic tests used to investigate disorders of pituitary, thyroid and parathyroid glands	C4						
			Discuss the pharmacological and surgical treatments							
90		Practical performance	Demonstrate the clinical examination of a patient with hyperthyroidism & hypothyroidism		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
91		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examinations and interpreting findings related to pituitary gland disorders			A4	Role Play			
TOPIC: Endocrinology (Diabetes, Adrenal & gonadic disorders)										
92	Week- 16	Introduction	Introduction to diabetes, adrenal & gonadic disorders	C1			Interactive Lecture/SGD	2	MCQs/SEQs	02
93		Classification	Explain classification diabetes, adrenal cortex and adrenal medulla diseases	C2						
94		Causes and risk factors	Describe common causes of diabetes and adrenal diseases	C2						
95		Pathophysiology, Clinical features	Explain the Pathophysiology of diabetes, adrenal diseases and gonadic disorders and identify the clinical features and symptoms	C3						
96		Diagnosis, treatment and prevention	Explain diagnostic approaches (clinical examination and Lab tests; RBS/FBS/HbA1c and blood tests for adrenal gland disorders).	C3						
			Discuss the pharmacological and surgical interventions of managing diabetes, adrenal disorders	C3						
94		Practical performance	Demonstrate clinical examination of a patient with adrenal gland problems		P4		Clinical Rotations Demo Videos	2	OSPE/OSCE	2
		SOPs compliance	Adopt Standard Operating Procedures (SOPs) for conducting physical examination and interpreting findings related to diabetes and adapting a lifestyle behavioral change			A4	Role Play			

Recommended Books:

1. Kumar and Clark's Clinical Medicine (Kumar, Kumar and Clark's Clinical Medicine), 10th edition
2. Davidson's Principles and Practice of Medicine, 21st edition
3. Clinical Medicine by Inam Danish 13 Edition

ASSESSMENT BREAKDOWN

S. No	Topics	No of MCQ	No of OSPE / OSCE Stations	Static / Interactive
1	Investigations & examination of CVS	03	0	
2	Acute coronary syndrome	06	1	Static and Interactive
3	Heart failure	05	1	Static
4	Diseases of heart valves	05	1	Interactive
5	Cardiomyopathies	03	1	Interactive
6	Cardiac arrhythmias	05	1	Interactive
7	Pericardial diseases	03	1	Static
8	COPD & Asthma	05	1	Static
9	Nephrotic syndrome & renal tumors	06	1	Interactive
10	Acute & chronic injury	05	1	Static
11	Urinary Tract infections	04	1	Interactive
12	Renal calculi and renal obstruction	04	1	Static
13	Investigations & examination of renal system	03	1	Static and Interactive
14	Pituitary & Thyroid disorders	05	1	Static
15	Diabetes mellitus	05	1	Static and Interactive
16	Adrenal disorders	03	0	
Total	**16**	**70**	**14**	**14**

CAR-607 ELECTROCARDIOGRAPHY – II

Course Description

This course equips students with the knowledge and skills to identify and interpret various cardiac pathologies using electrocardiography (ECG). They will learn to recognize abnormal ECG waveforms in different cardiovascular conditions and understand their clinical significance. By the end of the course, students will be proficient in analyzing pathological ECGs and accurately interpreting their findings in clinical practice.

Learning Objectives

Cognitive Domain:

By the end of the course, students will be able to:

1. Describe the heart electrical conduction and ECG waveforms.
2. Identify and differentiate components of the ECG, including P, QRS, and T waves.
3. Recognize abnormal ECG patterns and relate them to cardiac pathology.
4. Interpret ECG data to make accurate diagnoses.

Psychomotor Domain:

By the end of the course, students will be able to:

1. Demonstrate proper electrode placement for ECG.
2. Record high-quality ECGs with minimal noise and maximum patient comfort.
3. Interpret ECG waveforms to identify normal and abnormal patterns.

Affective Domain:

By the end of the course, students will:

1. Be punctual and professional.
2. Follow guidelines for interactive and group learning.
3. Communicate respectfully with peers, teachers, and patients.
4. Make ethical decisions in clinical and personal situation.

Table of Specification

TOS – ELECTROCARDIOGRAPHY – II 3 (2+1)

S. No	Weeks	Contents	Learning Outcome	Domain C	Domain P	Domain A	MIT's	Time/Hours	Assessment	No of Items
TOPIC: Review of Electrocardiography-I (Introduction to ECG)										
1	Week-1	Introduction	Define ECG and discuss its history	C1			Interactive Lecture	2	MCQs	03
2		Electrical activity of the heart	Explain the basic electrical activity of the heart.	C2						
3		ECG wave formation	Describe the formation and components of an ECG wave.	C2						
4		Practical performance	Demonstrate the normal ECG cycle, labeling P, QRS, T waves, and intervals using chart.		P1		Clinical Rotations Demo Videos	1	OSPE	01
5		SOPs compliance	Ensure accurate ECG chart demonstration with labeled waves, segments, and intervals.			A4	Role Play			
TOPIC: Review of Electrocardiography-I (ECG Leads and Grid)										
6	Week-2	ECG leads and electrodes	Identify the 12 ECG leads and understand the electrode placement for accurate ECG recording.	C1			Interactive Lecture	2	MCQs	03
7		ECG paper speed and Calibration	Discuss the significance of ECG paper speed (25mm/sec) and proper calibration for accurate readings.	C3						
8		ECG grid and normal values	Recognize the ECG grid structure and normal values for various waves and intervals							
9		Einthoven Triangle and Hex axial Reference System	Draw and explain the Einthoven Triangle and Hex axial Reference System to interpret heart electrical axis and lead orientation.	C2						
10		Practical performance	Demonstrate correct electrode placement for a 12-lead ECG, adjust paper speed and calibration.		P4		Clinical Rotations Demo Videos	1	OSPE	02
11		SOPs compliance	Adhere to SOPs for patient preparation, correct electrode placement, ECG calibration (1mV) and paper speed (25mm/sec).			A4	Role Play			
TOPIC: Review of Electrocardiography-I (Genesis of the QRS Complex and Vector Forces)										
12	Week-3	Normal Cardiac Vectors	Identify and explain the direction and significance of normal cardiac vectors	C1			Interactive Lecture	2	MCQs	03
13		QRS complex formation	Discuss the physiological processes involved in the formation of the QRS complex during ventricular depolarization.	C2						
14		Factors Affecting QRS Complex Amplitude	Explain how factors like heart position, body size, and diseases impact the amplitude of the QRS complex on an ECG.	C2						
15		Practical performance	Demonstrate cardiac vector analysis by using a chart to visualize and explain the direction of electrical impulses in the heart.		P4		Clinical Rotations Demo Videos	1	OSPE	01
16		SOPs compliance	Comply SOPs for cardiac vector analysis through appropriate chart.			A4	Role Play			

TOPIC: Review of Electrocardiography-I (Rate, Rhythm & Intervals)										
17	Week-4	Determination of heart rate	Discuss the methods for accurately determining heart rate from an ECG, including the rule of 300, 1500, and 6-second methods.				Interactive Lecture	2	MCQs/SEQs	03
18		Cardiac rhythm analysis	Describe how to analyze and interpret regular and irregular cardiac rhythms from ECG tracings.							
19		Calculation of intervals (PR, QRS, QT)	Explain how to measure and calculate the PR, QRS, and QT intervals on an ECG.							
20		Practical performance	Perform rhythm assessment using the Card method and calculate heart rate using the 300, 1500, and 6-second methods from ECG recordings.		P4		Clinical Rotations Demo Videos	1	OSPE	02
21		SOPs compliance	Adheres to SOPs by demonstrating professionalism, attentiveness, and ethical conduct during rhythm assessment, show a commitment to standardized guidelines.			A4	Role Play			
TOPIC: Cardiac Axis										
22	Week-5	Definition and Importance	Define cardiac axis and discuss the significance of the cardiac axis in ECG interpretation.	C1			Interactive Lecture	2	MCQs/SEQs	06
23		ECG Diagnostic criteria	Discuss the diagnostic criteria used for the determination of cardiac axis							
24		Differentiation between normal, left axis deviation (LAD), and right axis deviation (RAD)	Explain the key differentiating features of normal, left axis deviation (LAD), and right axis deviation (RAD) based on ECG.	C2						
25		Causes of Axis Deviation	Enlist the causes of axis deviation i.e. causes of LAD, RAD or ERAD.	C2						
26		Practical performance	Demonstrate normal axis, left axis deviation (LAD), right axis deviation (RAD), and extreme right axis deviation (ERAD) on a chart		P4		Clinical Rotations Demo Videos	1	OSPE	02
27		SOPs compliance	Comply SOPS for efficiently interpreting ECGs through proper lead analysis, systematic rhythm evaluation, and accurate identification of normal axis, LAD, RAD, and ERAD on a chart.			A4	Role Play			
TOPIC: Fascicular Block										
28	Week-6	Definition and Importance	Discuss the definition and significance of fascicular blocks in ECG interpretation.	C1			Interactive Lecture	2	MCQs/SEQs	04
29		ECG Diagnostic criteria	Explain the diagnostic criteria for identifying fascicular blocks using ECG.							
30		Differentiation between left anterior fascicular block (LAFB) and left posterior fascicular block (LPFB).	Describe how to differentiate between LAFB and LPFB based on ECG findings.	C2						
31		Causes of fascicular block	Enlist the potential causes of fascicular blocks	C2						
32		Practical performance	Demonstrate the left anterior fascicular block (LAFB) and left posterior fascicular block (LPFB) on an ECG /with a chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE	02
33		SOPs compliance	Comply SOPs for efficiently interpreting ECGs through proper lead analysis, systematic rhythm evaluation, and accurate identification of left anterior fascicular block (LAFB) and left posterior fascicular block (LPFB) with appropriate chart demonstration.			A4	Role Play			

TOPIC: Atrial Hypertrophy / P wave abnormalities										
34	Week-7	Normal P wave	Discuss the characteristics of a normal P wave	C2			Interactive Lecture	2	MCQs/SEQs	04
35		Left atrial enlargement (P Mitral)	Explain the ECG criteria for the diagnosis of left atrial enlargement (P mitrale)	C2						
36		Right atrial enlargement (P-Pulmonale)	Explain the ECG criteria for the diagnosis of right atrial enlargement (P-Pulmonale)	C2						
37		Biatrial enlargement	Explain the ECG criteria for biatrial enlargement	C2						
38		Practical performance	Demonstrate the normal P wave, left atrial enlargement (P mitrale), right atrial enlargement (P pulmonale), and biatrial enlargement on an ECG using chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
39		SOPs compliance	Comply SOPs for efficiently interpreting ECGs through accurate lead placement, systematic waveform analysis, and correct identification of normal P wave, left atrial enlargement (P mitrale), right atrial enlargement (P pulmonale), and biatrial enlargement using appropriate ECG.			A4	Role Play			
TOPIC: Ventricular hypertrophy										
40	Week-8	Definition and Types of Ventricular Hypertrophy	Define ventricular hypertrophy and classify its types with key distinctions based on ECG	C1			Interactive Lecture	2	MCQs/SEQs	04
41		ECG criteria for Left Ventricular Hypertrophy	Discuss the Sokolow-Lyon and Cornell voltage criteria for the diagnosis of LVH	C2						
42		ECG criteria for Right Ventricular Hypertrophy	Explain ECG diagnostic criteria for right ventricular hypertrophy	C2						
43		Causes of ventricular hypertrophy	Discuss the common causes of LVH and RVH	C2						
44		Practical performance	Demonstrate ECG findings of LVH and RVH using ECG charts.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
45		SOPs compliance	Comply SOPs for efficiently interpreting ECGs, and correct identification of normal P, QRS complex morphology, LVH/RVH using appropriate ECG.			A4	Role Play			
TOPIC: EKG of different syndromes causing heart disease										
46	Week-9	Wolff-Parkinson-White (WPW) Syndrome	Discuss ECG diagnostic criteria of WPW syndrome	C1			Interactive Lecture	2	MCQs/SEQs	05
47		Long QT Syndrome (LQTS)	Discuss ECG diagnostic criteria of Long QT syndrome	C1						
48		Brugada Syndrome	Discuss the types and ECG diagnostic criteria of Brugada Syndrome	C2						
49		Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)	ECG diagnostic criteria of Arrhythmogenic Right Ventricular Cardiomyopathy	C2						
50		Practical performance	Using ECG charts, identify key findings such as delta waves in WPW, prolonged QT in LQTS, ST-elevation in Brugada, and epsilon waves in ARVC, differentiate their ECG features.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
51		SOPs compliance	Comply SOPs for efficiently interpreting ECGs, and correct identification of normal ECG, delta Wave and epsilon using appropriate ECG.			A4	Role Play			
TOPIC: EKG of different Myocardial infarctions/ST Segment Abnormalities										
52	Week-10	Definition and Importance of the ST Segment	Define the ST segment and explain its importance in ECG interpretation.	C1			Interactive Lecture	2	MCQs/SEQs	05

53		Types of ST Segment Abnormalities	Describe ST elevation and ST depression and their respective clinical significance.	C2						
54		Causes and interpretation of ST Elevation	Explain the causes and clinical significance of ST elevation and interpret its ECG features.	C1						
55		Causes and Interpretation of ST depression	Discuss the causes and clinical significance of ST depression and interpret its ECG features.	C2						
56		Practical performance	Demonstrate ECGs of various types of ST segment abnormalities, including ST elevation and ST depression, using chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
57		SOPs compliance	Comply SOPs for efficiently interpreting ECGs with these abnormalities.			A4	Role Play			
TOPIC: Q Wave Abnormalities										
58	Week-11	Introduction	Discuss the normal characteristics of the Q wave	C1			Interactive Lecture	2	MCQs/SEQs	04
59		ECG criteria for abnormal Q wave	Explain the ECG criteria for pathological Q waves.	C2						
60		Causes of Pathological Q Waves	Discuss the causes of pathological Q waves, including myocardial infarction and other cardiac conditions.	C1						
62		Practical performance	Demonstrate various types of Q wave's myocardial infarction using appropriate ECG/chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
63		SOPs compliance	Comply SOPs for efficiently interpreting ECGs with these abnormalities.			A4	Role Play			
TOPIC: T wave Abnormalities										
64	Week-12	Introduction	Discuss the normal characteristics of the T wave, including its shape, direction, and amplitude.	C1			Interactive Lecture	2	MCQs/SEQs	03
65		Types of T wave abnormalities	Discuss common T wave abnormalities, such as inverted T waves, peaked T waves, flattened T waves, and biphasic T waves.	C2						
66		Causes of various T wave abnormalities	Enlist the causes of T wave abnormalities.	C1						
68		Practical performance	Demonstrate different types of T wave abnormalities using chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	01
69		SOPs compliance	Comply SOPs for efficiently interpreting ECGs with these abnormalities.			A4	Role Play			
TOPIC: Miscellaneous Conditions - Part I										
70	Week-13	Atrial Septal Defect (ASD)	Discuss the ECG diagnostic criteria of ASD	C1			Interactive Lecture	2	MCQs/SEQs	06
71		Pericarditis	Discuss the diagnostic criteria of pericarditis.	C1						
72		Long QT Interval Syndrome	Explain ECG diagnostic criteria for long QT syndrome.	C2						
73		Hypokalemia	Enlist ECG diagnostic criteria for hypokalemia.	C3						
74		Hyperkalemia	Discuss ECG diagnostic criteria for hyperkalemia.	C4						
75		Practical performance	Demonstrate different types of miscellaneous conditions using appropriate ECG/chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02

76		SOPs compliance	Comply SOPs for efficiently interpreting ECGs and findings for miscellaneous conditions on ECG paper/chart.			A4	Role Play			
TOPIC: Miscellaneous Conditions - Part II										
77	Week-14	Digitalis Effect	Discuss ECG criteria for Digitalis effect and toxicity.	C1			Interactive Lecture	2	MCQs/SEQs	06
78		Dextrocardia	Explain ECG features of Dextrocardia, focusing on right-axis deviation and reversed leads.	C2						
79		Electrical Alternans	Describe ECG findings in Electrical Alternans.	C3						
80		Electronic Pacing	Discuss ECG patterns in Electronic Pacing, including pacemaker spikes and paced rhythms.	C4						
81		Pulmonary Embolism	Explain ECG changes in Pulmonary Embolism.	C3						
82		Hypothermia, Hypercalcemia & Hypocalcemia	Describe ECG changes in Hypothermia, Hypercalcemia, and Hypocalcemia.	C4						
83		Hypokalemia and Hyperkalemia	Discuss ECG features of Hypokalemia and Hyperkalemia.	C4						
84		Practical performance	Demonstrate proper ECG electrode placement for dextrocardia.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	01
85		SOPs compliance	Comply SOPs for efficiently interpreting ECGs and findings for miscellaneous conditions on ECG paper/chart.			A4	Role Play			
TOPIC: Arrhythmias - Part-I (Sino atrial Node Arrhythmias & Atrial Arrhythmias)										
86	Week-15	Introduction to SA nodal arrhythmia	Define SA nodal arrhythmias.	C1			Interactive Lecture	2	MCQs/SEQs	06
87		Classification & ECG diagnostic criteria of SA nodal arrhythmia	Classify SA nodal arrhythmias and explain ECG diagnostic criteria of SA nodal arrhythmias.	C2						
88		Introduction to Atrial arrhythmia	Define and explain atrial arrhythmias.	C3						
89		Classification and ECG diagnostic criteria of atrial arrhythmia	Classify atrial arrhythmias and explain ECG diagnostic criteria of atrial arrhythmias.	C3						
90		Practical performance	Demonstrate ECG rhythm strip analysis of various types of SA nodal and atrial arrhythmias using chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
91		SOPs compliance	Comply SOPs for efficiently interpreting ECGs and ECG changes for Sino atrial Node & Atrial Arrhythmias.			A4	Role Play			
TOPIC: Arrhythmias - Part-II (Junctional Arrhythmias & Ventricular Arrhythmias)										
92	Week-16	Introduction to Junctional arrhythmia	Define Junctional arrhythmias based on ECG diagnostic criteria.	C1			Interactive Lecture	2	MCQs/SEQs	05
93		Classification and diagnostic criteria of Junctional arrhythmia	Classify Junctional arrhythmias and explain diagnostic criteria for each one.	C2						
94		Introduction to ventricular arrhythmias	Define ventricular arrhythmia and discuss its ECG diagnostic features.	C3						

95		Classification of ventricular arrhythmias	Classify ventricular arrhythmias and explain diagnostic criteria for each type.	C3						
96		Diagnostic criteria of ventricular arrhythmias	Apply diagnostic criteria to identify and diagnose ventricular arrhythmias.	C4						
97		Practical performance	Demonstrate ECG rhythm strip analysis of various types of ventricular arrhythmias using chart demonstration.		P4		Clinical Rotations Demo Videos	1	OSPE/OSCE	02
98		SOPs compliance	Comply SOPs for efficiently interpreting ECGs and ECG changes for Junctional Arrhythmias & Ventricular Arrhythmias.			A4	Role Play			

Recommended Books:

1. Rapid ECG interpretation by Mr. M. Gabriel Khan 3rd edition
2. EKG by Dale Dubin 6th edition
3. ECG in Medical Practice by Abdullah

ASSESSMENT BREAKDOWN				
S. No	**Topics**	**No of MCQ**	**No of OSPE / OSCE Stations**	**Static / Interactive**
1	Review of Electrocardiography-I (Introduction to ECG)	03	0	
2	Review of Electrocardiography-I (ECG Leads and Grid)	03	01	Static and Interactive
3	Review of Electrocardiography-I (Genesis of the QRS Complex and Vector Forces)	03	0	
4	Review of Electrocardiography-I (Rate, Rhythm & Intervals)	03	01	Interactive
5	Cardiac Axis	06	01	Interactive
6	Fascicular Block	04	01	Interactive
7	Atrial Hypertrophy / P wave abnormalities	04	01	Static
8	Ventricular Hypertrophy	04	01	Static
9	EKG of different syndromes causing heart disease	05	01	Interactive
10	EKG of different Myocardial infarctions/ST Segment Abnormalities	05	01	Static
11	Q Wave Abnormalities	04	01	Interactive
12	T Wave Abnormalities	03	01	Static
13	Miscellaneous Conditions - Part I	06	01	Static and Interactive
14	Miscellaneous Conditions - Part II	06	01	Static
15	Arrhythmias - Part-I (Sino atrial Node Arrhythmias & Atrial Arrhythmias)	06	01	Static and Interactive
16	Arrhythmias - Part-II (Junctional Arrhythmias & Ventricular Arrhythmias)	05	01	Static and Interactive
Total	16	70	14	14

CAR-609 Medical Physics 3(2+1)

Course Description:

This course provides an in-depth exploration of medical physics principles crucial for perfusion and cardiology technology students. It focuses on the fundamental concepts and their practical applications in cardiopulmonary and cardiovascular function and monitoring. Designed for students pursuing careers in perfusion and cardiology technology, the course aims to enhance understanding of the physical principles underlying diagnostic and therapeutic techniques used in cardiopulmonary and cardiovascular care.

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Recall key medical physics concepts explain physical laws and physiological processes in the human body.
2. Utilize physics principles to operate and interpret cardiopulmonary monitoring devices.
3. To assess the accuracy and reliability of medical measurements and devices.

Psychomotor Domain:

By the end of this course, students should be able to:

1. Identify the need for precise measurements in clinical settings.
2. Prepare medical devices for use following standard operating procedures.
3. Operate cardiopulmonary and cardiovascular devices proficiently and efficiently.

Affective Domain:

By the end of this course, students should be able to:

1. Show interest in the application of medical physics.
2. Appreciate the significance of accurate diagnostics in patient care
3. Integrate physical principles into clinical practice.

Table of Specification

CAR-609 MEDICAL PHYSICS

S. No	Weeks	Content	Learning Outcome	Domain			MIT's	Time/ Hours	Assessment	No of Items
				C	P	A				
TOPIC: Introduction to medical physics and Mathematical Principles										
1	Week-1	Introduction	Define medical physics, its Major branches and its significance in healthcare.	C1			Interactive Lecture/SDG		MCQS/SEQS	04
2		Application	Explain applications of physics to medical diagnosis and treatment.	C2						
3		Physical measurement and calibration	Explain the principles of physical measurement and the importance of calibration in medical devices.	C2						
4		SI units	List the seven base SI units and their corresponding physical quantities.	C3						
5		Derived Units and prefixes	Convert measurements between different SI units, e.g. force, pressure, energy. work, power etc.	C3						
6		Practical	Demonstrate and practice basic calibration procedures for a medical device e.g., blood pressure monitor, ECG machine and echo. Along with Units and its Conversion.		P2 P4		Demo		OSPE	02
7		SOPs Compliance	How handle equipment with professionalism and adherence to guidelines. Adhere to standard calibration protocols to ensure patient safety, follow precise procedures to maintain device accuracy, report and rectify errors in compliance with ethical standards.			A3 A4	Role Play			
TOPIC: Physical principles (Gas Laws and Flow Pattern)										
8	Week-2	Gas Laws	Explain the basic principles of Boyle's law, Charles's law along with its medical application.	C2			Interactive Lecture/SDG		MCQS/SEQS	04
9		Gas Laws	Explain the basic principles of Gay- Loussac law and its medical application.	C2						
10		Flow Pattern	Explain Flow pattern e.g. Laminar and turbulent Flow.	C2						
11		Hagen-Poiseuille equation	**Describe** Hagen-Poiseuille equation for **hemodynamics** (blood flow in vessels).	C3						
12		Reynolds's number	Explain Reynold's number to predict flow pattern (whether flow is Laminar or Turbulent)	C2						
13		Practical	Perform experiments for demonstrating the gas laws (Boyl, s law and Charles law) and their medical applications. Demonstrate laminar and turbulent flow using fluid models.		P4		Demo		OSPE	02
14		SOPs Compliance	Adhere to standard experimental protocols to ensure accurate observations			A4	Role Play			
TOPIC: Physical principles (Bernoulli, Venturi, Coanda and law conservation of energy)										
15	Week-3	Bernoulli's Principle	Explain Bernoulli's principle to explain fluid dynamics in medical contexts.	C2			Interactive Lecture/SDG		MCQS/SEQS	04
16		Venturi and Coanda Effects	Explain the Venturi effect and Coanda effect.	C2						

17		Application	Apply Bernoulli's principle to explain fluid dynamics in medical contexts and Venturi effect and Coanda effect application in medical devices.	C3						
18		Law of conservation of energy	Describe Law of conservation of energy.	C4						
19		Practical	Demonstrations of Bernoulli's principle, Venturi and Coanda effects using lab setups.		P4		Demo		OSPE	02
20		SOPs Compliance	Comply Sops for practical of each effect.			A4	Role Play			
TOPIC: Physical principles (Heat and temperature, Latent heat, **S**olubility and diffusion and Cleaning, disinfection and sterilization)										
21	Week-4	Heat and temperature	Define heat and temperature and their differences.	C1			Interactive Lecture/SDG		MCQS/SEQS	05
22		Latent Heat	Describe the concept of latent heat and its role in phase changes.	C2						
23		**S**olubility and diffusion	Explain the principles of solubility and diffusion along with various laws in biological systems.	C2						
24		Osmosis and colligative properties	Describe osmosis, colligative properties and its importance/application in physiological processes/medical solutions.	C3						
25		Cleaning, disinfection and sterilization	Define Cleaning, disinfection and sterilization	C1						
26		Practical	Perform experiments to observe solubility and diffusion.		P4		Demo		OSPE	02
27		SOPs Compliance	Comply sops for this experiment.			A4	Role Play			
TOPIC: Principles of Pulse oximetry										
28	Week-5	Pulse oximetry	Define pulse oximetry	C1			Interactive Lecture/SDG		MCQS/SEQS	04
29		Purposes and indications	Explain purposes and indication for pulse Oximetry	C2						
30		Principle of Pulse oximetry	Explain principle of pulse oximetry	C2						
31		Beer lambert's law	Describe beer and Lamberts law in pulse oximetry	C3						
32		Oxy-Hb and Deoxy-Hb absorption spectra	Describe Oxy-Hb and Deoxy-Hb absorption spectra in pulse oximetry	C4						
33		Practical	Demonstrate Measurement of Oxygen Saturation at Rest and After Exercise Using a Pulse Oximeter		P4		Demo		OSPE	02
34		SOPs Compliance	Adopt how to care pulse Oximeter and precise measurement.			A4	Role Play			
TOPIC: Principles of Capnometer										
35	Week-6	Capnometer and Capnography	Define Capnometer and Capnography	C1			Interactive Lecture/SDG		MCQS/SEQS	04
36		Principle	Explain the physics behind Capnography	C3						
37		Normal capnograph	Describe Normal capnograph and its phases	C3						
38		Pattern of Capnograph	Describe the shape and meaning of different capnograph traces	C4						
39		Traces in various medical condition	Describe the clinical applications of capnograph	C4						
40		Practical	Interpretation of Medical Conditions Using Capnography Traces		P4		Demo		OSPE	02
41		SOPs Compliance	Comply SOPs for interpretation			A4	Role Play			
TOPIC: Principles of Absorption of carbon dioxide in canister										

42	Week-7	Absorption of CO2	Define Absorption of CO2 in Canister	C1			Interactive Lecture/SDG			03
43		Mesh size	Explain the significance of granule size in CO2 absorption and its impact on gas flow resistance	C2						
44		**Chemical Reaction**	Describe the chemical reaction involved in CO2 absorption and its stages	C3						
		Color Indicators	Describe the role of color indicators in monitoring CO2 absorption efficiency	C4						
45		Practical	Observation of Color Change in CO_2 Absorbent Canisters		P4		Demo		OSPE	01
46		SOPs Compliance	Comply Sops for this practical observation.			A4	Role Play			
TOPIC: Respiratory physiology										
47	Week-8	Lung Volumes and capacities	Identify and define the different lung volumes and capacities.	C1			Interactive Lecture/SDG			05
48		Spirometry	Introduction to Spirometry.	C1						
49		Normal Spirometry	Explain Normal Spirometry	C2						
50		Restrictive and Obstructive Lung Diseases	Describe Restrictive and Obstructive Lung Diseases Using Spirometry	C3						
51		Flow–Volume Loops	Describe the normal flow-volume loop and its significance.	C3						
52		Practical	Assessment lung function using Spirometry and predict obstructive or restrictive lung diseases based on FEV1, FVC, and the FEV1/FVC ratio.		P4		Demo		OSPE	02
53		SOPs Compliance	Adopt how to interpret Spirometry report properly.			A4	Role Play			
54	Week-9	The alveolar gas equation	Introduction The alveolar gas equation	C1			Interactive Lecture/SDG			07
55		The alveolar gas equation	Apply the alveolar gas equation to calculate alveolar oxygen pressure.	C3						
56		Shunt Equation	Explain the shunt equation	C2						
57		Shunt Equation calculation	**Describe shunt equation** to calculate the **percentage of cardiac output that bypasses ventilated alveoli**	C3						
58		Pulmonary Vascular Resistance	Explain PVR and the factors affecting pulmonary vascular resistance.	C2						
59		Ventilation/Perfusion Mismatch	Describe ventilation/perfusion mismatch and its consequences.	C3						
60		Dead Space	Differentiate between anatomical and physiological dead space.	C2						
61		Fowler's Method	Apply Fowler's method to measure anatomical dead space.	C3						
62		Bohr Equation	Explain the Bohr equation and its use in calculating physiological dead space.	C2						
63		Practical	Measure dead space using the Bohr equation.		P4		Demo		OSPE	01
64		SOPs Compliance	Adhere proper steps for calculating dead space using Bohr equation.			A4	Role Play			
TOPIC: Oxygen delivery and transport										

65	Week-10	Oxygen cascade	Describe the oxygen cascade to describe the decreasing oxygen tension from the atmosphere to the mitochondria.	C3			Interactive Lecture/SDG			05
66		DO2	Explain the calculation of oxygen delivery (DO_2) and its determinants.	C2						
67		Pasture point	Describe the factors influencing oxygen unloading at tissues and the role of the Pasteur point.	C3						
68		Henry law	Explain oxygen carriage in blood, including the role of hemoglobin and Henry's Law.	C2						
69		Oxygen flux	Describe oxygen flux and its calculation.	C3						
70		Differentiation	Differentiate between oxygen supply-dependent and supply-independent states.	C3						
71		O2 Extraction Ratio	Apply the concept of oxygen extraction ratio (O_2ER) in clinical scenarios.	C4						
72		Practical	Calculate oxygen content and DO2 using the formula.		P4		Demo		OSPE	01
73		SOPs Compliance	Comply sops.			A4	Role Play			
TOPIC: Oxyhemoglobin Dissociation Curve (ODC)										
74	Week-11	Oxyhemoglobin Dissociation Curve (ODC)	Explain the significance of the Oxyhemoglobin dissociation curve in oxygen transport.	C2			Interactive Lecture/SDG			07
75		P50 and Oxygen Saturation	Define P50 and describe its role in determining hemoglobin oxygen affinity.	C2						
76		Factors Affecting the Oxyhemoglobin Dissociation Curve	Describe the factors causing a right or left shift in the Oxyhemoglobin dissociation curve and their physiological significance.	C3						
77		The Bohr Effect	Explain the Bohr effect and its role in oxygen unloading at the tissue level.	C2						
78		The Haldane Effect	Describe the Haldane effect and its impact on carbon dioxide transport.	C3						
79		Carriage of Carbon Dioxide in Blood	Explain the different forms in which carbon dioxide is transported in the blood.	C2						
80		Chloride Shift (Hamburger Effect)	Describe the chloride shift mechanism and its role in maintaining acid-base balance during gas exchange.	C3						
81		Practical	Demonstrates increased CO_2 production and its effect on oxygen unloading at tissues.		P4		Demo		OSPE	01
82		SOPs Compliance	How did this experiment change your perception of **oxygen transport in the body?**			A4	Role Play			
TOPIC: Cardiovascular Physiology										
83	Week-12	Cardiac Action Potentials	Explain the phases of cardiac action potentials and their significance.	C2			Interactive Lecture/SDG			06
84		The Cardiac Cycle	Describe the phases of the cardiac cycle and their physiological significance. Apply knowledge of the cardiac cycle to explain the sequence of events during a heartbeat.	C2 C3						
85		Pressure and Flow Calculations	Apply principles of hemodynamics to calculate pressure and flow in the cardiovascular system.	C3						
86		Central Venous Pressure	Explain the significance of central venous pressure (CVP) and its measurement.	C2						
87		Pulmonary Arterial Wedge Pressure	Explain the clinical importance of pulmonary arterial wedge pressure (PAWP) and its measurement.	C2						

88		Frank–Starling Relationship	Apply the Frank–Starling law to explain cardiac function.	C3						
89		Practical	Perform pressure and flow calculations using clinical data. Measure central venous pressure using simulation models. Demonstrate the measurement of PAWP using simulation tools.		P2		Demo	OSPE		02
90		SOPs Compliance	Comply SOPs for CVP measurement and PAWP.			A4				
TOPIC: Cardiovascular Physiology (Venous return and capillary dynamics)										
91	Week-13	**Venous Return**	Define venous return and describe its dependence on pressure relations	C1			Interactive Lecture/SDG			05
92		**Mean Systemic Filling Pressure (MSFP)**	Explain MSFP and its role in venous return	C2						
93		**Capillary Dynamics**	Define and explain key capillary forces (hydrostatic & oncotic pressures)	C1						
94		**Starling's Principle of Fluid Movement**	Calculate and interpret net filtration pressure using Starling's equation	C3						
95		**Capillary Filtration and Reabsorption**	Differentiate between filtration and absorption at different capillary locations	C3						
96		Practical	Demonstration of Frank-Starling Mechanism		P2		Demo	OSPE		02
97		SOPs Compliance	Adopt how to use simulation model for Frank-starling relationship.			A4				
TOPIC: Systemic and pulmonary vascular resistance										
98	Week-14	SVR	Introduction to Systemic vascular resistance	C1			Interactive Lecture/SDG			03
99		PVR	Define pulmonary vascular resistance	C1						
100		Equation	Describe Equation for SVR and PVR.	C2						
101		Ventricular Pressure–Volume Relationship	Analyze ventricular pressure–volume loops and their clinical significance.	C3						
102		Practical	Calculate systemic and pulmonary vascular resistance using clinical data.		P2		Demo	OSPE		01
103		SOPs Compliance	Follow standard units and guidelines for vascular resistance calculations to ensure consistency.			A2	Role Play			
TOPIC: The Valsalva maneuver										
104	Week-15	Introduction	Define **Valsalva maneuver**	C1			Interactive Lecture/SDG			02
105		Phases	Explain phases of **Valsalva maneuver**	C2						
106		Uses	Describe uses of	C3						
		Abnormal responses	Describe Abnormal responses in **Valsalva maneuver**	C4						
		Practical	Demonstrate the physiological effects of the Valsalva Maneuver on cardiovascular function and autonomic regulation		P4		Demo	OSPE		01
		SOPs Compliance	Adopt professionalism in cardiovascular assessment.			A4	Role Play			
TOPIC: Neuromuscular Blockade Monitoring										
107		Introduction	**Introduction to Neuromuscular Blockade Monitoring**	C1			Interactive Lecture/SDG			03
108		Mechanism and Importance of Monitoring	Explain Mechanism and Importance of Monitoring	C2						

109	Week-16	**Depolarizing and Non-Depolarizing Block**	**Describe Depolarizing and Non-Depolarizing Block**	C3						
110		**Train of Four Ratio (TOFR)**	**Describe Train of Four Ratio (TOFR)**	C3						
111		Practical	Demonstrate to Understand the principles of neuromuscular monitoring and proper electrode placement.		P4		Demo	OSPE		01
112		SOPs Compliance	Comply SOPs for NMB monitoring.			A4	Role Play			

Recommended Books:

1. Physics, Pharmacology and Physiology for Anesthetists by Matthew E. Cross. Cambridge latest edition
2. Introduction to Biological Physics for the Health and Life Sciences, 2nd Edition by Kirsten Franklin.
3. Physics and body by John R 2nd edition

ASSESSMENT BREAKDOWN

S. No	Topics	No of MCQ	No of OSPE / OSCE Stations	Static / Interactive
1	Introduction to medical physics and Mathematical Principles	4	1	Static
2	Physical principles (Gas Laws and Flow Pattern)	4	1	Static
3	Physical principles (Bernoulli, Venturi, Coanda and law conservation of energy)	4	1	Interactive
4	Physical principles (Heat and temperature, Latent heat, Solubility and diffusion and Cleaning, disinfection and sterilization)	5	1	Static
5	Principles of Pulse oximetry	4	1	Interactive
6	Principles of Capnometer	4	1	Static and Interactive
7	Principles of Absorption of carbon dioxide in canister	3	1	Statistic
8	Respiratory physiology	5	1	Static and Interactive
9	Respiratory physiology	7	1	Statistic
10	Respiratory physiology	5	1	Statistic
11	Oxyhemoglobin Dissociation Curve (ODC)	7	1	Static and Interactive
12	Cardiovascular Physiology	6	1	Statistic
13	Cardiovascular Physiology (Venous return and capillary dynamics)	5	1	Statistic
14	Systemic and pulmonary vascular resistance	3	0	Nil
15	The Valsalva maneuver	2	1	Interactive
16	**Neuromuscular Blockade Monitoring**	2	0	Nil
Total	**16**	**70**	**14**	**14**

CAR – 601 / CP-603 ECHOCARDIOGRAPHY-I / ECHOCARDIOGRAPHY 3(2+1)

Course Description:

This course provides an in-depth understanding of echocardiography, including its historical evolution, physical principles, and practical applications in cardiac imaging. Students will explore the development and implementation of various echocardiographic modalities such as M-mode, 2D imaging, Doppler and contrast echocardiography. Emphasis is placed on acquiring and interpreting standard echocardiographic views, understanding normal cardiac anatomy and quantifying ventricular function. Students will also gain foundational knowledge in ultrasound physics and instrumentation and develop skills in operating echocardiographic equipment.

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Understand the history and evolution of echocardiography from M-mode to 3D and contrast techniques.
2. Describe the physical principles of ultrasound and instrumentation including wave propagation, reflection, refraction, attenuation, and resolution and define and explain basic terms such as frequency, wavelength, acoustic impedance, and echogenicity
3. Explain Doppler principles, including color, pulsed, and continuous wave Doppler and spectral analysis
4. Identify normal cardiac anatomy in echocardiographic views and describe the standard anatomical echocardiographic views, including parasternal, apical, subcostal, and suprasternal.
5. Discuss the quantification of ventricular function, including systolic and diastolic performance.

Psychomotor Domain:

By the end of this course, students should be able to:

1. Acquire standard transthoracic echocardiographic views (PLAX, PSAX, A4C, subcostal).
2. Perform M-mode, 2D, and Doppler imaging of cardiac structures.
3. Perform Doppler velocity measurements across valves and within chambers.
4. Identify anatomical landmarks measure chamber dimensions.
5. Demonstrate proper patient positioning and probe manipulation.

Affective Domain:

By the end of this course, students should be able to:

1. Demonstrate professionalism and ethics during patient interaction and scanning procedures.
2. Show respect and empathy towards patients undergoing echocardiographic exams.
3. Value the role of echocardiography in diagnosis and patient care.
4. Collaborate effectively with physicians and other allied health staff during exams.

Table of Specification

Echocardiography-I

S. No	Weeks	Contents	Learning Outcome	Domain C	Domain P	Domain A	MIT's	Time/ Hours	Assessment	No of Items
TOPIC: Introduction to Echocardiography-I										
1	Week-1	Introduction	Define Echocardiography	C1			Interactive Lecture	2	MCQs	3
2		History	Discuss the history of Echocardiography	C2						
3		Types	Explain different types of echocardiography	C3						
4		Practical performance	Demonstrate basic scanning techniques for 2D, M-mode and Color Doppler Echo. Hands-on introduction to 2D echo and M-mode scanning and basic settings (gain, depth, focus).		P4		Demo/Practical	1	OSPE/OSCE	02
5		SOPs compliance	Comply SOPs and ensure all students about historical context and can accurately define echocardiography and understand its role.			A4	Role Play			
TOPIC: Basic Principles of Ultrasound										
6	Week-2	Introduction	Define ultrasound waves and its relevance in cardiac imaging.	C1			Interactive Lecture	2	MCQs	4
7		Acoustic impedance	Describe acoustic impedance and its role in image formation and reflection.	C2						
8		Frequency and Attenuation	Explain the relationship between ultrasound frequency and image resolution/depth and different causes and effects of attenuation in ultrasound propagation.	C3						
9		Practical performance	Identify parts of the ultrasound machine. Apply gel to phantom or volunteer. Adjust Gain to observe brightness changes. Adjust Depth to focus on superficial and deeper structures.		P4		Demo/Practical	1	OSPE/OSCE	01
10		SOPs compliance	Comply SOPs to ensure that students comprehend the fundamental physics behind ultrasound imaging and proper and safe preparation of the ultrasound equipment.			A4	Role Play			
TOPIC: Instrumentation – Echo machine components and knobology										
11	Week-3	Machine Console Overview	Identify major components of the echocardiography machine console (monitor, trackball, keyboard, transducer port).	C1			Interactive Lecture	2	MCQs	2
12		Transducer Types	Differentiate between various probes used in echo.	C2						
13		Knobology & Controls	Describe basic controls including gain, depth, focus, freeze, and zoom.	C2						
14		Practical performance	Demonstrate proper handling, cleaning and safety practices for transducers. Hands-on introduction to 2D echo and M-mode scanning and basic settings (gain, depth, focus). Identification of external components of echocardiography machine (Display monitor/screen, Control panel, keyboard, Probe (transducer) ports, Probes (transducers) types (phased array, linear), CG module for cardiac synchronization, CPU (central processing unit) section,		P4		Demo/Practical	1	OSPE/OSCE	02

			Power cables and connectivity ports.							
15		SOPs compliance	Comply SOPs to ensure all students can correctly identify and describe external parts of an echocardiography machine.			A4	Role Play			
TOPIC: Transducer Types and its applications										
16	Week-4	Types of Transducers	Classify different types of transducers used in echocardiography.				Interactive Lecture	2	MCQs/SEQs	5
17		Transducer Selection	Explain the clinical indications for using each type of transducer (e.g., transthoracic, transesophageal).							
18		Transducer Function	Discuss how transducer frequency affect resolution and penetration.							
19		Practical performance	Identification of different transducers (Phased Array Transducer, Linear Array Transducer, TEE (Trans esophageal Echocardiography) Probe and Non-Imaging Probe. Discuss key points about transducer handling, cleaning, and safety.		P4		Demo/Practical	1	OSPE/OSCE	02
20		SOPs compliance	Comply SOPs to Identify different types of transducers and describe their primary clinical uses and match the transducer to the clinical need for optimal imaging.			A4	Role Play			
TOPIC: M-mode Echocardiography										
21	Week-5	Introduction to M-mode	Define M-mode and explain its basic principle and scanning line orientation.	C1			Interactive Lecture	2	MCQs/SEQs	5
22		Clinical Use of M-mode	Discuss clinical applications of M-mode in cardiac chamber and valve assessment.	C2						
23		M-mode Interpretation	Identify and interpret basic M-Mode echocardiographic findings and key parameters LVEDD, LVESD, interventricular septum (IVS) and posterior wall (PW) thickness. Mitral valve E-point to septal separation (EPSS) and motion patterns and Calculate Ejection Fraction (EF) and Fractional Shortening (FS).	C3						
24		Practical performance	Position the patient in the left lateral decubitus position. Perform a basic M-Mode examination independently under supervision. Analyze M-Mode tracings to derive cardiac measurements. Optimize image quality by adjusting gain, depth, and focus settings.		P4		Demo/Practical	1	OSPE/OSCE	02
25		SOPs compliance	Comply SOPs to choose M-Mode from the machine's imaging options.			A4	Role Play			
TOPIC: Echocardiography Artifacts										
26	Week-6	Introduction to Artifacts	Define echocardiography artifacts and their importance in image interpretation.	C1			Interactive Lecture	2	MCQs/SEQs	3
27		Identify artifacts in 2D, M-mode, and Doppler echocardiography	Explain different sources of artifacts in 2D, M-mode and Doppler echocardiography.	C2						
28		Techniques to minimize artifacts during imaging	Discuss different Techniques to minimize artifacts during imaging	C3						
29		Practical performance	Identify different types of artifacts in real-time echocardiographic scans. Practice manipulating machine settings to troubleshoot artifacts		P4		Demo	1	OSPE/OSCE	01
30		SOPs compliance	Comply SOPs for carefully observe for artifacts such as Reverberation artifact and aliasing in Doppler			A4	Role Play			
TOPIC: Doppler Principles										

31	Week-7	Introduction to basic physics of Doppler effect	Define and explain basic physics of Doppler effect.	C2			Interactive Lecture	2	MCQs/SEQs	5
32		Types of Doppler used in echocardiography	Discuss different types of Doppler used in echocardiography (Continuous Wave, Pulsed Wave, Color Flow and Tissue Doppler Imaging). .	C3						
33		Clinical Application	Explain clinical applications of 2D, M-mode, continuous Wave, Pulsed Wave and color Flow.	C3						
34		Practical performance	Hands-on use of 2D, M-mode, continuous Wave, Pulsed Wave and color Flow		P4		Demo	1	OSPE/OSCE	02
35		SOPs compliance	Comply SOPs for 2D, M-mode, continuous Wave, Pulsed Wave and color Flow			A4	Role Play			
TOPIC: Doppler Calculations										
36	Week-8	Bernoulli's Equation	Explain the simplified Bernoulli equation to calculate pressure gradients across cardiac valves.	C1			Interactive Lecture	2	MCQs/SEQs	5
37		Clinical Application	Interpret velocity data from CW Doppler and calculate peak/mean pressure gradients.	C1						
38		Continuity equation	Define the continuity equation and apply it for calculating aortic valve area (AVA).	C2						
39		PISA Method	Define PISA method and how to apply in valvular stenosis and regurgitation	C2						
40		Practical performance	Apply the Bernoulli equation to estimate gradients across valves. Identify appropriate echocardiographic views for each Doppler measurement. Demonstrate AVA calculation using velocity time integral (VTI) and LVOT measurements.		P4		Demo	1	OSPE/OSCE	01
41		SOPs compliance	Comply SOPs for accurate patient position, machine setup and doppler acquisition and calculations.			A4	Role Play			
TOPIC: Parasternal Views										
42	Week-9	Parasternal Long Axis (PLAX)	Describe probe position and anatomical orientation for acquiring the PLAX view.	C1			Interactive Lecture	2	MCQs/SEQs	5
43		Interpretation of PLAX	Identify cardiac structures (LV, LA, AV, MV, IVS, PW) and assess their motion in PLAX view.	C1						
44		Parasternal Short Axis (PSAX)	Explain PSAX view at different levels (aortic valve, mitral valve, papillary muscle and apical level).	C2						
45		Practical performance	Demonstrate and perform PLAX and PSAX views using transthoracic approach on patients/models at different levels.		P4		Practical	1	OSPE/OSCE	02
46		SOPs compliance	Comply SOPs for accurate patient position, machine setup, transducer placement and image acquisition.			A4	Role Play			
TOPIC: Apical Views										
47	Week-10	Apical 4-Chamber View (A4C)	Explain probe placement and anatomical structures and imaging planes visualized in apical views A4C view.	C2			Interactive Lecture	2	MCQs/SEQs	4
48		Apical 2-Chamber View (A2C)	Describe probe placement and anatomical structures and imaging planes visualized in apical views A2C view.	C3						
49		Apical 3-Chamber View (A3C)	Explain probe placement and anatomical structures and imaging planes visualized in apical views A3C view.	C3						

50		Practical performance	Identify and perform appropriate intercostal space and transducer orientation for each apical view		P4		Practical	1	OSPE/OSCE	02
51		SOPs compliance	Comply SOPs for accurate patient position, transducer placement and image acquisition.			A4	Role Play			
TOPIC: Subcostal & Suprasternal Views										
52	Week-11	Subcostal Views	Describe the technique for obtaining subcostal 4-chamber and IVC views and their clinical significance.	C2			Interactive Lecture	2	MCQs/SEQs	4
53		Subcostal and suprasternal echocardiographic images	Explain Subcostal and suprasternal echocardiographic images.	C3						
54		Clinical use of subcostal and suprasternal views	Discuss Clinical use of subcostal and suprasternal views.	C3						
55		Practical performance	Perform and observe subcostal 4-chamber view to assess septal motion and effusion. Subcostal IVC view to estimate central venous pressure (IVC diameter and collapsibility) and suprasternal long-axis view to assess aortic arch and its branches.		P4		Practical	1	OSPE/OSCE	02
56		SOPs compliance	Comply SOPs for accurate patient position, transducer placement, structure visualization and image acquisition			A4	Role Play			
TOPIC: Chamber Quantification										
57	Week-12	Left Ventricular (LV) Quantification	Describe M-mode and 2D methods to assess LV internal dimensions, volume, and mass.	C1			Interactive Lecture	2	MCQs/SEQs	4
58		Right Ventricular (RV) Measurements	Explain techniques to assess RV basal, mid, and longitudinal dimensions.	C2						
59		Atrial Measurements	Identify proper methods for LA and RA size assessment.	C1						
60		Practical performance	Perform measurements of all four chambers using appropriate echocardiographic views.		P4		Practical	1	OSPE/OSCE	02
61		SOPs compliance	Comply SOPs for accurate patient position, transducer placement, structure visualization and image acquisition and proper chamber quantification on echocardiography			A4	Role Play			
TOPIC: Quantification of Ventricular Diastolic Performance										
62	Week-13	Definition and normal diastolic function	Define Diastolic dysfunction and normal diastolic function	C1			Interactive Lecture	2	MCQs/SEQs	6
63		Diastolic Filling Phases and grades of diastolic dysfunction	Describe the phases of ventricular diastole (isovolumic relaxation, early filling, atrial contraction) and grades of diastolic dysfunction.	C2						
64		Echo doppler parameters of diastolic dysfunction	Explain echo doppler parameters of diastolic dysfunction.	C3						
65		Tissue Doppler Imaging (TDI) mitral annular velocity	Explain Tissue Doppler Imaging (TDI) mitral annular velocity	C3						
55		Pulmonary & Hepatic Veins flow	Quantification and interpretation of pulmonary and hepatic veins flow in different phases of diastolic dysfunction	C3						
67		Practical performance	Identify patterns of impaired relaxation, pseudoformal filling, restrictive filling and Grade diastolic function using a standardized algorithm.		P4		Demo/Practical	1	OSPE/OSCE	02

68		SOPs compliance	Comply SOPs for accurate patient position, transducer placement, structure visualization, interpretation grading and image acquisition (mitral inflow using CW and PW doppler).			A4	Role Play			
TOPIC: Quantification of Left Ventricular Systolic Performance										
69	Week-14	Definition	Define Systolic Dysfunction and its causes.	C1			Interactive Lecture	2	MCQs/SEQs	6
70		Linear measurements, 2D, M-mode Doppler & M-mode Quantification	Explain Linear measurements, 2D, M-mode quantification of left ventricular systolic function.	C2						
71		LV wall segment and regional function	Describe LV wall segment and regional function.	C3						
72		Simpson Method	Explain Calculation LV volume through Simpson Method for quantification of Ejection Fraction, Fractional shortening.	C3						
73		Doppler evaluation of LV function	Explain Doppler evaluation (the velocity integral TVI and dp/dt) of LV function	C3						
74		Practical performance	Measure LVEDD and LVESD in parasternal long-axis using M-mode to calculate FS and Simpson's method for EF		P4		Demo/Practical	1	OSPE/OSCE	01
75		SOPs compliance	Comply SOPs for accurate patient position, transducer placement, structure visualization, M-mode for fractional shortening, Simpson's method for EF and doppler method stroke volume, cardiac output, TVI and dp/dt.			A4	Role Play			
TOPIC: Quantification of Right Ventricular Function										
76	Week-15	Definition	Define RV Dysfunction and its causes	C1			Interactive Lecture	2	MCQs/SEQs	4
77		M-mode & Doppler	Explain Quantification RV stroke volume, M-mode pulmonary valve movement analysis, calculation of TAPSE on m-mode and S wave on tissue doppler	C2						
78		RV size and Volume and TR velocity	Describe Quantification of RV volume on Simpson method, calculation of RV size and classification of RV dysfunction according to RV size and TR velocity and estimation of PASP in RV failure	C3						
79		Practical performance	Optimize an RV-focused apical 4-chamber view by centering the RV apex and maximizing RV size. Measure TAPSE from M-mode at lateral tricuspid annulus. Measure S' velocity using pulsed wave TDI.		P4		Demo/Practical	1	OSPE/OSCE	02
80		SOPs compliance	Comply SOPs for accurate patient position, transducer placement, structure and image acquisition TAPSE Measurement and TDI S' Velocity.			A4	Role Play			
TOPIC: Contrast Echo										
81	Week-16	Introduction	Define contrast echo and contrast agents	C1			Interactive Lecture	2	MCQs/SEQs	5
82		Indications and types of contrast agents used in echocardiography	Describe Indications and types of contrast agents used in echocardiography	C2						
83		Contrast-enhanced echocardiographic studies and Shunts detection	Describe Contrast-enhanced echocardiographic studies and Shunts detection.	C3						
84		Masses and LV non compaction	Role of contrast echo in detection of LV masses and LV non compaction	C3						
85		Detection of wall thickness	Role of contrast echo in detection of LV apical hypertrophy and detection of wall thickness in poor echo views	C3						

86		Practical performance	Assist and observe in patient preparation for contrast studies. Prepare agitated saline for bubble studies. Inject contrast through appropriate IV access and time image acquisition with injection.		P4		Demo	1	OSPE/OSCE	01
87		SOPs compliance	Comply SOPs for accurate patient position Contrast Agent Preparation, Microbubble Contrast (Left Heart Contrast) and image acquisition			A4	Role Play			

Recommended Books:

1. Feigunbaum's Echocardiography,7th Edition
2. Echo Made Easy, by Sam Kaddoura, 2nd Edition
3. Echo Made Easy, by Atul Luthra, 2nd Edition

ASSESSMENT BREAKDOWN				
S. No	**Topics**	**No of MCQ**	**No of OSPE / OSCE Stations**	**Static / Interactive**
1	Introduction to Echocardiography-I	03	1	Interactive
2	Basic Principles of Ultrasound	04	1	Static
3	Instrumentation – Echo machine components and knobology	02	1	Interactive
4	Transducer Types and its applications	05	1	Static
5	M-mode Echocardiography	05	1	Interactive
6	Echocardiography Artifacts	03	0	Nil
7	Doppler Principles	05	1	Interactive
8	Doppler Calculations	05	1	Static and Interactive
9	Parasternal Views	05	1	Interactive
10	Apical Views	04	1	Interactive
11	Subcostal & Suprasternal Views	04	1	Interactive
12	Chamber Quantification	04	1	Static and Interactive
13	Quantification of Ventricular Diastolic Performance	06	1	Static and Interactive
14	Quantification of Left Ventricular Systolic Performance	06	1	Static and Interactive
15	Quantification of Right Ventricular Function	04	1	Static and Interactive
16	Contrast Echo	05	0	Nil
Total	**16**	**70**	**14**	**14**

CAR-605 ELECTROPHYSIOLOGY 3(2+1)

Course Description:

This course provides an in-depth understanding of cardiac electrophysiology, covering the fundamental principles of electrical conduction in the heart, mechanisms of arrhythmias, and clinical electrophysiological procedures. Students will learn about normal and abnormal cardiac rhythms, electrophysiological mapping, and therapeutic interventions, including pacemakers, implantable cardioverter-defibrillators (ICDs), cardiac resynchronization therapy device implantation and radiofrequency catheter ablation techniques. Hands-on practice will be integrated to develop technical skills necessary for assisting in electrophysiological studies and cardiac rhythm devices implantation procedures.

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Explain the physiological basis of cardiac electrophysiology, including action potentials and conduction pathways.
2. Identify common cardiac arrhythmias and their underlying mechanisms.
3. Describe the principles and techniques of electrophysiological studies (EPS) and therapeutic interventions.
4. Discuss the indications, contraindications, and complications of catheter ablation and device implantation.

Psychomotor Domain:

By the end of this course, students should be able to:

1. Perform basic ECG and Holter monitoring interpretation for arrhythmia detection.
2. Assist in electrophysiological studies and device implantation procedures under supervision.
3. Demonstrate proper handling and placement of leads for pacemakers and ICDs.

Affective Domain:

By the end of this course, students should be able to:

1. Demonstrate ethical considerations and professionalism while dealing with patients undergoing electrophysiological procedures.
2. Exhibit teamwork and communication skills in an electrophysiology lab setting.
3. Display empathy and patient-centered care when explaining procedures and outcomes.

Table of Specification

ELECTROPHYSIOLOGY 3(2+1)

S. No	Weeks	Content	Learning Outcome	Domain			MIT's	Time/ Hours	Assessment	No of Items
				C	P	A				
TOPIC: INTRODUCTION TO CARDIAC ELECTROPHYSIOLOGY										
1	Week-1	Introduction	Define cardiac electrophysiology	C1			Interactive Lecture/SGD	2	MCQs	03
2		Procedures	List diagnostic and therapeutic procedures performed in electrophysiology (EP) lab	C1						
3		Classification	Classify various cardiac implantable devices and their functions	C2						
4		Practical Performance	Confidently differentiate between diagnostic and therapeutic EP catheters using visual tools and reference guides independently		P4		Demo	2	OSPE/OSCE	02
5		SOPs Compliance	Comply to the SOPs of identification protocols, including proper labeling and verification of catheter types during simulated tasks			A4	Role Play			
TOPIC: FUNDAMENTALS OF ELECTROPHYSIOLOGY (Part-I)										
6	Week-2	Cardiac Ion Channels	Describe the role of various ion channels in cardiac myocytes	C2			Interactive Lecture/SGD	2	MCQs	02
7		Cardiac Action Potentials	Explain cardiac action potentials and the role of ion channels	C2						
8		Electric Coupling	Explain electrical coupling and the function of gap junctions	C2						
9		Practical Performance	Identify various phases of nodal cell and myocardial cell action potentials using charts independently		P4		Demo	2	OSPE/OSCE	02
10		SOPs Compliance	Comply to the SOPs of chart handling and image interpretation for independent nodal phases of nodal cell and myocardial cell APs			A4	Role Play			
TOPIC: FUNDAMENTALS OF ELECTROPHYSIOLOGY (Part-II)										
11	Week-3	Introduction	Define arrhythmias	C1			Interactive Lecture/SGD	2	MCQs	05
12		Classification	Classify the mechanisms of arrhythmias	C1						
13		Mechanism	Explain the mechanisms of cardiac arrhythmias	C2						
14		Practical Performance	Analyze various supraventricular, junctional and ventricular arrhythmias using ECG rhythm strips		P4		Demo	2	OSPE/OSCE	02
15		SOPs Compliance	Comply to the SOPs of electrocardiographic interpretation for independent identification of various arrhythmias			A4	Role Play			
TOPIC: BASIC EP LAB SET-UP AND EQUIPMENT										
16	Week-4	Equipment	Define the necessary equipment for device implantation	C1			Interactive Lecture/SGD	2	MCQs	06
17		Organization	Describe the organization of the arrhythmia lab	C1						
18		Setup of EP Lab	Explain the set-up of the interventional electrophysiology laboratory	C2						
19		Junction Box	Identify the function of a junction box in an EP lab	C1						
20		Recording Apparatus	List the components of a recording apparatus.	C1						
21		Stimulator	Explain the role of a stimulator in electrophysiological studies	C2						

22		Defibrillator	Describe the function of a cardioverter/defibrillator in arrhythmia management	C2						
23		Radiofrequency Ablation	Explain the principles of radiofrequency ablation (RFA)	C2						
24		Mapping System	Describe the role of mapping systems in electrophysiology procedures	C2						
25		Practical Performance	Identify different electrophysiology lab equipment using schematic diagrams and physical layouts independently		P4		Demo	2	OSPE/OSCE	02
26		SOPs Compliance	Comply to the SOPs of standard lab preparation protocols, ensuring safe and logical setup of EP lab stations and device handling			A4	Role Play			
TOPIC: HOLTER AND EVENT MONITOR LABORATORY SET-UP										
27	Week-5	Definition	Define ambulatory ECG (AECG) monitoring	C1			Interactive Lecture/SGD	2	MCQs	04
28		Indications	List the indications for ambulatory ECG monitoring	C2						
29		Components of ambulatory ECG monitoring laboratory	Describe the components of an ambulatory ECG monitoring laboratory	C2						
30		Laboratory Setup & Equipment	Explain the function of recording devices and storage of transmitted data	C2						
31		Types of Ambulatory ECG Monitoring	Differentiate between continuous and intermittent/memory loop AECG monitoring	C2						
32		Recorder Maintenance & Patient Preparation	Identify procedures for recorder maintenance and preparation	C1						
33			Explain the selection of lead systems for AECG	C2						
34		Patient Care & Post-Monitoring Procedures	Explain patient instructions and pre-examination procedures	C2						
35			Demonstrate the removal of the Holter recorder post-monitoring	C3						
36		Device Selection & Recording Duration	Describe criteria for device selection and recording duration in AECG monitoring	C2						
37		Practical Performance	Demonstrate proper electrode placement and site preparation independently		P4		Demo	2	OSPE/OSCE	02
38		SOPs Compliance	Comply to the SOPs of electrode handling, site preparation, and proper electrode placement techniques independently			A4	Role Play			
TOPIC: BRADYCARDIA & CONDUCTION DISORDERS										
39	Week-6	Introduction	Define bradycardia and its clinical significance	C1			Interactive Lecture/SGD	2	MCQs	05
40		Pathophysiology	Explain the pathophysiology of bradycardia	C2						
41		Disorders of the sinus node	Describe disorders of the sinus node (e.g., sinus bradycardia, sinus arrest)	C2						
42		Disorders of atrioventricular (AV) and His-Purkinje conduction	Explain disorders of atrioventricular (AV) and His-Purkinje conduction (e.g., AV block types)	C2						
43		Bradycardia in Specific Conditions	Explain bradycardia in specific conditions like neurally mediated bradycardia, post-surgical bradyarrhythmia's, and bradyarrhythmia's secondary to medications	C2						
44		Diagnostic Evaluation	Enlist various diagnostic tools for detecting bradyarrhythmia's	C2						
45		Practical Performance	Analyze and interpret various bradyarrhythmia's and conduction blocks using ECG rhythm strips independently		P4		Demo	2	OSPE/OSCE	02
46		SOPs Compliance	Comply to the SOPs of electrocardiographic analysis and			A4	Role Play			

			interpretation for bradyarrhythmia's and various conduction blocks							
TOPIC: CARDIAC IMPLANTABLE ELECTRONIC DEVICES (CIEDS)										
47	Week-7 and Week-8	Introduction	Define cardiac implantable electronic devices (CIEDs)	C1			Interactive Lecture/SGD	2	MCQs	06
48		Types	List types of CIEDs, including pacemakers, ICDs, and CRT devices	C1						
49		Properties and Nomenclature	Describe the properties and nomenclature of CIEDs	C2						
50		Indications	Describe the function and indications of permanent pacemakers	C2						
51		Modes	Explain different programming modes of a CIED	C2						
52		Components	Explain the components of a basic CIED system	C2						
53		Indications and Working	Describe the function, indications, and working mechanism of ICDs	C2						
54		Defibrillator Threshold Testing (DFT)	Explain defibrillator threshold testing (DFT) and its significance	C2						
55		Device Procedure	Explain the criteria for patient selection for pacemaker and ICD implantation	C2						
56		Patient Preparation	Describe the steps involved in patient preparation before implantation	C2						
57		Procedures	Explain the various steps of the surgical procedure for Pacemaker, ICD, and CRT implantation	C2						
58		Complications	Identify early and late complications of CIEDs	C1						
59		ICD Specific Complications	Enlist ICD specific complications	C1						
60		Infections	Describe CIED infections, their types and treatment	C2						
61		Practical Performance	Identify various CIEDs using physical or illustrated device models		P4		Demo	2	OSPE/OSCE	02
62		SOPs Compliance	Comply to the SOPs of device identification and handling for independent recognition of various cardiac implantable devices			A4	Role Play			
TOPIC: SUDDEN CARDIAC DEATH AND INHERITED ARRHYTHMIAS										
63	Week-9	Introduction	Define sudden cardiac death (SCD) and its clinical significance	C1			Interactive Lecture/SGD	2	MCQs	04
64		Mechanism, Causes, Investigations, Prognosis and Risk Assessment	Explain the mechanisms, causes, investigations, prognosis and risk assessment for SCD	C2						
65		Causes in Athletes	Describe the causes of SCD in athletes	C2						
66		Screening Protocols	Explain screening protocols for SCD in athletes	C2						
67		Exercise Restrictions	Recommend appropriate exercise restrictions for individuals with SCD risk factors	C3						
68		Inherited Arrhythmias	Explain causes, mechanisms, types, diagnosis, treatment and prognosis of LQTS, SQTS, Brugada Syndrome and CPVT	C2						
69		Practical Performance	Identify ECG patterns indicative of inherited syndromes such as Brugada syndrome and Long QT syndrome		P4		Demo	2	OSPE/OSCE	02
70		SOPs Compliance	Comply to the SOPs of ECG analysis and interpretation			A4	Role Play			
TOPIC: SUPRAVENTRICULAR TACHYARRHYTHMIA (PART-I)										
71	Week-10	Introduction	Define tachycardia and its clinical significance.	C1			Interactive Lecture/SGD	2	MCQs	06
72		Epidemiology	Summarize the epidemiology of tachyarrhythmias.	C1						
73		Classification	Classify different types of tachycardias based on mechanism and origin	C2						
74		Clinical Features	Describe the clinical presentation of various tachyarrhythmias.	C2						

75		Atrial Tachycardia	Explain prevalence, mechanisms, clinical features, symptoms, and management and treatment of Atrial Tachycardia, Focal Atrial Tachycardia, Multifocal Atrial Tachycardia	C2					
76		Atrial Flutter and Macroreentrant Atrial Tachycardia	Explain prevalence, mechanisms, clinical features, symptoms, and management and treatment of Atrial Flutter and Macroreentrant Atrial Tachycardia	C2					
77		Practical Performance	Distinguish between types of supraventricular tachycardias based on ECG characteristics		P4		Demo	2	OSPE/OSCE	02
78		SOPs Compliance	Comply to the SOPs for classifying tachyarrhythmias, ensuring accurate documentation			A4	Role Play			
TOPIC: SUPRAVENTRICULAR TACHYARRHYTHMIA (PART-II)										
79	Week-11	Atrial Fibrillation	Describe epidemiology, classification, risk factors, clinical features, and management of Atrial Fibrillation	C2			Interactive Lecture/SGD	2	MCQs	07
80		AVRT and AVNRT	Describe classification, clinical features, pathophysiology, investigations and management of AVRT and AVNRT	C2						
81		Practical Performance	Distinguish between types of supraventricular tachycardias based on ECG characteristics		P4		Demo	2	OSPE/OSCE	02
82		SOPs Compliance	Comply to the SOPs for classifying tachyarrhythmias, ensuring accurate documentation			A4	Role Play			
TOPIC: PERFORMING BASIC EP STUDIES										
83	Week-12	Indications	Explain the purpose and indications of basic EP studies.	C2			Interactive Lecture/SGD	2	MCQs	07
84		Complications	List complications associated with EP studies	C2						
85		Venous and Arterial Access	Describe venous and arterial access for EP study	C2						
86		Standard Catheter Position	Describe standard catheter positions in EP studies	C2						
87		Intracardiac Electrograms	Define intracardiac electrograms (EGMs)	C1						
88		Classification	Classify different types of EGMs and their significance	C2						
89		Basic Conduction Intervals	Interpret basic conduction intervals in EGMs	C3						
90		Refractory Period	Define the refractory period and its significance	C1						
91		Classification	Explain the concept of the relative refractory period (RRP), functional refractory period (FRP) and effective refractory period (ERP)	C2						
92		Practical Performance	Practical performance of performing a basic EP study through video demonstration		P4		Demo	2	OSPE/OSCE	02
93		SOPs Compliance	Comply to the SOPs of patient identification, preparation and equipment setup for performing basic EP studies			A4	Role Play			
TOPIC: BASIC EP STUDY PROTOCOLS & MANEUVERS										
94		Introduction	Define the purpose and importance of basic EP study protocols	C1			Interactive Lecture/SGD	2	MCQs	05
95		Maneuvers	Describe key maneuvers used in EP studies for arrhythmia diagnosis	C2						
96		Principles	Explain the principles of programmed electrical stimulation (PES) in EP studies	C2						
97		Terminologies	Define essential pacing stimuli terminologies	C1						
98		Coupling Interval	Explain the concept of coupling interval	C2						
99		Pacing Protocols	Explain various atrial & ventricular pacing protocols	C2						

100	Week-13	Sinus Node Testing	Explain sinus node function testing, including Sinus Node Recovery Time (SNRT) and Sinoatrial Conduction Time (SACT)	C2					
101		Practical Performance	Practical performance of performing EP maneuvers through video demonstration		P4		Demo	2	OSPE/OSCE	02
102		SOPs Compliance	Comply to the SOPs of various EP study protocols and maneuvers			A4	Role Play			
TOPIC: CATHETER ABLATION TECHNIQUES										
103	Week-14	Ablation of AVNRT and AVRT	Describe catheter ablation of AVNRT and AVRT	C2			Interactive Lecture/SGD	2	MCQs	05
104		Ablation of CTI-dependent Atrial Flutter	Explain ablation of cavotricuspid isthmus (CTI)-dependent atrial flutters	C2						
105		Practical Performance	Practical performance of performing RF ablation through video demonstration		P4		Demo	2	OSPE/OSCE	02
106		SOPs Compliance	Comply with the SOPs for safety protocols for RF ablation, including catheter inspection, energy settings, and procedural safety steps.			A4	Role Play			
TOPIC: SYNCOPE										
107	Week-15	Introduction	Define syncope and its clinical significance	C1			Interactive Lecture/SGD	2	MCQs	05
108		Prevalence	Summarize the incidence and prevalence of syncope in different populations.	C1						
109		Classification	Classify the etiology of syncope (e.g., neurocardiogenic, cardiac, orthostatic, neurological)	C2						
110		Pathophysiology	Explain the underlying pathophysiology of different types of syncope	C2						
111		Clinical Assessment	Describe the steps in the clinical assessment of a patient presenting with syncope	C2						
112		Investigations	Explain the role of investigations in syncope evaluation	C2						
113		Treatment	Recommend treatment options, including lifestyle modifications, medication, and device therapy (e.g., pacemakers for Bradyarrhythmia-related syncope)	C3						
114		Practical Performance	Practical performance of assessment of a patient with syncope through video demonstration		P4		Demo	2	OSPE/OSCE	02
115		SOPs Compliance	Comply to the SOPs of patient assessment with syncope			A4	Role Play			
TOPIC: TILT TABLE TEST										
116	Week-16	Introduction	Define the Tilt Table Test (TTT) and its purpose	C1			Interactive Lecture/SGD	2	MCQs	05
117		Indications	Explain the indications for performing a Tilt Table Test	C2						
118		Patient Preparation	Describe essential steps in patient preparation	C2						
119		Procedure	Explain the step-by-step procedure of the Tilt Table Test	C2						
120		Responses	Classify the types of responses to the Tilt Table Test	C3						
121		Interpretation	Explain interpretation of test results and correlation with clinical symptoms	C3						
122		Practical Performance	Practical performance of performing Tilt Table Test through video demonstration		P4		Demo	2	OSPE/OSCE	02
123		SOPs Compliance	Comply to the SOPs of performing and monitoring the tilt table test, ensuring patient safety, accurate measurement of vital signs, and adherence to established procedural protocols			A4	Role Play			

Recommended Books:
1. The clinical cardiac electrophysiology Handbook – 2016 edition by Jason G. Andrade, MD
2. Handbook of Cardiac Electrophysiology – Edited by Andrea Natale MD

ASSESSMENT BREAKDOWN				
S. No	**Topics**	**No of MCQ**	**No of OSPE / OSCE Stations**	**Static / Interactive**
1	Introduction to Electrophysiology	3	1	Static
2	Fundamentals of Electrophysiology (Part-I)	2	1	Interactive
3	Fundamentals of Electrophysiology (Part-II)	5	1	-
4	Basic electrophysiology Lab setup and equipment	6	1	Interactive
5	Holter and event monitor laboratory set-up	4	1	Static and Interactive
6	Bradycardia and conduction disorders	5	1	Interactive
7	Cardiac Implantable Electronic Devices (CIEDs)	6	1	Interactive
8	Cardiac Implantable Electronic Devices (CIEDs)	0	0	-
9	Sudden Cardiac death and ventricular arrhythmias	4	1	Interactive
10	Supraventricular tachyarrhythmia (part-I)	7	1	Static
11	Supraventricular tachyarrhythmia (part-II) and ventricular tachyarrhythmias	7	1	Static and Interactive
12	Performing Basic EP study	7	1	Interactive
13	Basic EP study protocols and maneuvers	5	1	Interactive
14	Catheter Ablation Techniques	5	-	Static
15	Syncope	5	-	Static
16	Tilt Table Test	5	1	Interactive
Total	**16**	**70**	**14**	**14**

BS Cardiology Technology – CAR-608 Interventional Cardiology 3(2+1)

Course Description:

This course provides an in-depth understanding of Interventional Cardiology focusing on diagnostic and therapeutic procedures performed in the Cardiac Catheterization Laboratory (Cath Lab). It covers essential topics such as angiographic techniques, vascular access, coronary interventions, hemodynamic assessment, pharmacological management and radiation safety. Students will also learn about the latest advancements in percutaneous coronary interventions (PCI), balloon angioplasty, stenting, PTMC and management of complex coronary lesions.

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Understand the radiation safety protocols and contrast media used in Cath Lab procedures.
2. Demonstrate knowledge of vascular access techniques and various angiographic views.
3. Identify different guiding catheters, guidewires, balloons, and stents used in PCI.
4. Understand and assist in advanced interventional procedures, including left main coronary artery interventions, chronic total occlusion (CTO) procedures, primary PCI in STEMI and PTMC.
5. Explain hemodynamic assessment and its role in diagnosing cardiovascular conditions.
6. Discuss pharmacological agents including vasopressors, vasodilators, and antithrombotic used in Cath Lab.

Psychomotor Domain:

By the end of this course, students should be able to:

1. Perform fundamental interventional cardiology procedures under supervision.
2. Handle and administer vasopressors, vasodilators and antithrombotic agents correctly.
3. Conduct hemodynamic assessments using invasive pressure monitoring techniques.
4. Identify and access vascular entry sites using proper sterile techniques.
5. Position angiographic views accurately for optimal coronary imaging.
6. Analyze different types of guiding catheters and guidewires.
7. Assist in percutaneous coronary interventions (PCI), primary PCI for STEMI patients, chronic total occlusion (CTO) and Perform Percutaneous Transvenous Mitral Commissurotomy (PTMC).

Affective Domain:

By the end of this course, students should be able to:

1. Demonstrate teamwork in Cath Lab procedures and emergency interventions.
2. Uphold ethical standards when handling vasopressors, vasodilators and antithrombotic.
3. Value precision and accuracy in hemodynamic monitoring and vascular access techniques.
4. Demonstrate responsibility in maintaining ethical practices in interventional cardiology.
5. Show commitment to patient safety by adhering to radiation protection guidelines.

Table of Specification

INTERVENTIONAL CARDIOLOGY

S. No	Weeks	Content	Learning Outcome	Domain			MIT's	Time/ Hours	Assessment	No of Items
				C	P	A				
TOPIC: AN INTRODUCTION TO INTERVENTIONAL CARDIOLOGY										
1	Week-1	Introduction	Define interventional Cardiology	C1			Interactive Lecture/SDG		MCQS	03
2		History	Explain historical background of interventional cardiology early developments, key milestones and technological advancements	C2						
3		Procedure	Describe indications, contraindications, risk and complications in cardias catherization lab	C2						
4		Practical Performance	Identify essential equipment used in a cardiac catheterization laboratory (e.g., fluoroscopy machine, hemodynamic monitors, crash cart and catheter sets.		P4		Demo		OSPE/OSCE	02
5		Comply SOPs	Comply SOPs Patient identity verification and consent confirmation and Checklist completion (allergy history, renal function tests, coagulation profile).			A4	Role Play			
TOPIC: RADIATIONS SAFETY, CONTRAST MEDIA, PATIENT SELECTION										
6	Week-2&3	Introduction	Define radiation safety, contrast media and patient selection in cardiac catherization lab	C2			Interactive Lecture/SDG		MCQS/SEQS	07
7		Safety, fundamentals of Xray tube and Principle of radiation	Describe fundamentals of X ray tube, principles and safety of radiation in cardiac catherization lab	C2						
8		Mechanism and radiation dosage measurements	Explain Mechanism and radiation dosage measurements	C2						
9		Types and mechanism of contrast media and allergic reactions	**Explain types, mechanism of contrast media and allergic reactions of contrast media**	C3						
10		Patient selection, indications, contraindications approaches for cardiac catherization	Explain Patient selection, indications, contra indications approaches for cardiac catherization	C3						
11		Practical	Perform how to Use personal protective equipment (PPE) like lead aprons, thyroid shields, and lead glasses and radiation shielding using barriers and proper C-arm positioning. Identification of contrast media and managing contrast allergies, Renal function assessment and hydration protocols before contrast use and patient selection for interventional procedures		P4		Demo		OSPE/OSCE	02
12		SOPs Compliance	Adhere to Comply SOPs proper used of lead shielding before fluoroscopy begins, Screen patients for allergies and renal function pre-procedure and Document selection criteria in patient records			A4	Role Play			
TOPIC: VASOPRESSORS, VASODILATORS AND ANTI THROMBOTICS IN THE CATHERIZATION LABORATORY										

13	Week-4	Introduction	Explain role of vasopressors, vasodilators and anti-thrombotic in cardiac catherization lab	C2			Interactive Lecture/SGD		MCQS/SEQS	05
14		Pharmacologic fundamentals of vasopressors, vasodilators and uses	Explain pharmacologic fundamentals of vasopressors, vasodilators and uses common agents in cardiac catherization lab	C3						
15		Overview and pharmacological fundamentals of antithrombotic agents and its categories	Describe Overview and pharmacological fundamentals of antithrombotic agents, its categories and use in cardiac Cath lab	C4						
16		Practical	Demonstrations of proper preparation, identification and administration of IV vasopressors, anti-thrombotic agents and vasodilators		P4		Demo		OSPE/OSCE	02
17		SOPs Compliance	Comply SOPs for proper administration of vasopressors, vasodilators and anti-thrombotic in cardiac catherization lab			A4	Role Play			
TOPIC: HEMODYNAMIC ASSESSMENT										
18	Week-5	Introduction to hemodynamics and its principles	Explain basic hemodynamics principles preload, afterload, contractility and cardiac output.	C1			Interactive Lecture/SDG		MCQS/SEQS	04
19		Overview and pressure measurements for right and left heart catheterization	Describe Overview and pressure measurements for right heart (RA, RV, PA, PCWP) and left heart (LV, Aortic pressure) in cardiac catheterization lab	C2						
20		Wave analysis and calculations	Explain Interpretation of pressure tracings (a, c, v waves; systolic/diastolic phases), Pressure-volume loops and Hemodynamic patterns in diseases: tamponade, AS, MR, cardiogenic shock. Describe Cardiac output and index (Fick and thermodilution methods). Pulmonary vascular resistance (PVR) and systemic vascular resistance (SVR).	C2 C3						
21		Procedure	Explain step by step procedure to Prepare the patient and equipment for hemodynamic monitoring. Assist in catheter placement (femoral, radial, or jugular access). Zero and calibrate transducers to atmospheric pressure and record pressures from RA, RV, PA, and PCWP or LV and Ao.	C3						
22		Practical	Perform and observe simulated recording of right and left heart pressures. Interpretation of real-time waveforms during cardiac cath and Performing hemodynamic calculations (e.g., CO, PVR, SVR).		P4		Demo		OSPE	02
23		SOPs Compliance	Comply SOPs to confirm patient identity and indication for monitoring. Ensure proper zeroing of transducers at the phlebostatic axis. Label all waveforms clearly and consistently during left and right heart catheterization.			A4	Role Play			
TOPIC: VARIOUS SITES OF VASCULAR ACCESS										
24	Week-6	Definition	Define different vascular approaches	C1			Interactive Lecture/SDG		MCQS/SEQS	04
25		Types	Explain different types of vascular access and approaches	C2						
26		Techniques	Explain different techniques for vascular approaches (e. g arterial, Venous)	C2						
27		Complications	Describe different complications during vascular access	C3						
28		Practical	Demonstrate Assisting in real-time arterial/central venous access (under supervision) and handling complications (e.g., hematoma, dislodgement)		P4		Demo		OSPE/OSCE	02

29		SOPs Compliance	Comply SOPs how to assess Seldinger technique (guidewire, dilator, catheter).			A4	Role Play			
TOPIC: ANGIOGRAPHIC VIEWS, CORONARY ANGIOGRAPHIC ASSESSMENT										
30	Week-7	Definition	Define basic coronary anatomy	C1			Interactive Lecture/SDG		MCQS/SEQS	04
31		Basic angiographic views	Explain basic angiographic views	C3						
32		Guideline for moving intensifier	Describe different guidelines for moving intensifier for proper angiographic views	C3						
33		Standard angiographic views	Describe different standard angiographic views	C4						
34		Technical Tips	Describe different technical tips for exposing different coronary arteries (LAD.LCX and RCA)	C4						
35		Practical	Label standard coronary angiographic views and Identification of normal and diseased coronary segments.		P4		Demo		OSPE/OSCE	02
36		SOPs Compliance	Comply SOPs for Prepare sterile field and assist in vascular access setup. Angiographic view acquisition for different coronaries arteries.			A4	Role Play			
TOPIC: PRACTICAL ANALYSIS OF GUIDE DESIGN OF CATHETERS										
37	Week-8	Definition and structures	Define guide and diagnostic catheters and its structure	C1			Interactive Lecture/SDG			05
38		Types	Explain different types of guiding and diagnostic catheters (Judkins (R/L), Amplatz (R/L), Multipurpose, EBU, AL, XB, Tiger, Jacky, etc.)	C2						
39		**Technical tips**	Describe different technical tips for engaging and dis engaging of guiding and diagnostic catheters in different coronaries arteries	C3						
		Color Indicators	Describe the role of color indicators in monitoring CO2 absorption efficiency	C4						
40		Practical	Identification of different types of guiding and diagnostic catheters (Judkins (R/L), Amplatz (R/L), Multipurpose, EBU, AL, XB, Tiger, Jacky, etc.).		P4		Demo		OSPE/OSCE	01
41		SOPs Compliance	Comply SOPs to confirm different catheter type, size (French), length, and curve.			A4	Role Play			
TOPIC: GUIDE WIRES										
42	Week-9	Definition and general structurer	Define guide wires and its structure	C1			Interactive Lecture/SDG			05
43		Components and characteristics	Explain different components and characteristics of different guide wires	C2						
44		Technical Tips	Describe different technical tips advancing guide wires in different coronary arteries in main and side branches during procedure	C3						
45		Flow–Volume Loops	Describe the normal flow-volume loop and its significance.	C3						
46		Practical	Confirm guide wire type and size on packaging (length, tip shape, coating). Identification of guide wire types and their uses and use of torque device during procedure		P4		Demo		OSPE/OSCE	02
47		SOPs Compliance	Comple SOPs to confirm guide wire type and size on packaging (length, tip shape, coating).			A4	Role Play			
TOPIC: ANGIOPLASTY BALLOON & STENTING										
48		Definition	Define angioplasty balloons	C1			Interactive			12

49	Week-10 &11	Types and technical tips	Explain different types of angioplasty balloon and different maneuver to crossing lesions	C2			Lecture/SDG			
50		Historical perspective of coronary stents types and its compositions	Explain historical perspective of coronary stents types (Bare-metal stents (BMS), Drug-eluting stents (DES) and its composition	C3						
51		Different strategies for crossing stents and angioplasty balloons	**Describe** Different strategies for crossing stents during angioplasty and angioplasty balloons	C3						
52		Practical	Set up manifold, inflation device and hemodynamic monitoring. Prepare required guiding catheters, guide wires, balloons, stents. Set up manifold, inflation device, and hemodynamic monitoring Assist in guide wire crossing. Prepare and hand over balloon and stent systems.		P4		Demo		OSPE/OSCE	01
53		SOPs Compliance	Comply SOPs use of appropriate guiding catheter (extra back-up, EBU, etc.) Correct angioplasty balloon, stents type and size based on lesion. Flush balloon catheter with saline.			A4	Role Play			
TOPIC: LEFT MAIN CORONARY ARTERY PROCEDURES										
54	Week-12	Anatomy and clinical significance	Describe anatomy and clinical significance of left main disease.	C3			Interactive Lecture/SDG			06
55		Intervention and different technical tips, imaging view of LMCA Intervention	Describe different Intervention and technical tips, techniques, views and Catheter selection for LMCA procedure (Bifurcation techniques: TAP, Culotte, DK Crush, T-Stenting and Use of IVUS/OCT	C2						
56		Practical	Hands-on practice with angioplasty balloon, stents, inflation devices and stent delivery system Appropriate catheters for LMCA access and LMCA bifurcation stenting techniques Assist in guide wire crossing. Prepare and hand over balloon and stent systems		P4		Demo		OSPE/OSCE	01
57		SOPs Compliance	Comply SOPs use of appropriate guiding catheter (extra back-up, EBU). Correct balloon type and size based on lesion. Flush balloon catheter with saline			A4	Role Play			
TOPIC: OSTIAL LESIONS										
58	Week-13	Definition and common involve origins LMCA, RCA, LAD, and LCx	Define Ostial lesion and common involve origins	C2			Interactive Lecture/SDG			05
59		Intervention and different technical tips, imaging view, Catheter and wire selection	Describe different Intervention and technical tips, techniques, views and Catheter selection for Ostial lesion	C2						
60		Balloon and stents	Explain balloon and stents selection for ostial lesion	C3						
61		Practical	Ostial lesion identification on angiography. Preparing devices for ostial PCI (balloons, stents, IVUS, inflation devise). Select appropriate guiding catheter (e.g., EBU, JL, JR for optimal coaxially). Prepare balloon and stent with precision size and length. Assist in careful guide positioning to avoid pressure damping		P4		Demo		OSPE/OSCE	01
62		SOPs Compliance	Comply SOPs for selection of catheter with adequate support and coaxial alignment and stent at recommended pressure and duration Angiographic sequences at key stages: pre, during, post-stent			A4	Role Play			
TOPIC: PRIMARY PERCUTANEOUS CORONARY INTERVENTION IN ST SEGMENT ELEVATION IN MYOCARDIAL INFARCTION (STEMI)										
63	Week-14	Definition	Define Primary and PCI	C2			Interactive Lecture/SDG		OSPE/OSCE	05
64		Primary PCI and risk assessment	Describe Primary PCI and its risk assessment for procedure	C2						
65		Balloon and stent	Explain different Intervention and technical tips, techniques, views and	C3						

			Catheters, balloons and stent selection for Primary PCI							
66		Complex Primary PCI	Explain different Intervention and technical tips, techniques, for Complex Primary PCI	C3						
67		Advantage and Limitation	Explain different advantage and limitation of Complex Primary PCI.	C3						
68		Practical	Hands-on handling of PPCI devices (guide catheters, wires, balloons, stents) Prepare and deliver guide wire, balloon, and stent as instructed		P2		Demo			02
69		SOPs Compliance	Comply SOPs for Selection of appropriate guiding catheter (usually JL or JR), drugs, angioplasty balloons and stents			A4				
TOPIC: PERCUTANEOUS TRANSLUMINAL COMMISSUROTOMY (PTMC)										
70	Week-15	Introduction to Mitral Stenosis and indications for PTMC	Explain mitral stenosis and indications for PTMC	C1			Interactive Lecture/SDG			05
71		Patient selection criteria for PTMC	Explain Patient selection criteria for PTMC	C2						
72		Equipment used in PTMC & Pre-procedure evaluation (Echocardiography, TEE)	Explain Equipment used in PTMC (Balloon catheter, transseptal needle, sheaths) & Pre-procedure evaluation (Echocardiography, TEE)	C3						
73		Step-by-step PTMC procedure & Monitoring hemodynamics during the procedure	Describe Step-by-step PTMC procedure & Monitoring hemodynamics during the procedure	C3						
74		**Clinical aspects and limitations**	Explain **Clinical aspects and limitations of PTMC**	C3						
75		Practical	Demonstration of PTMC equipment setup and handling. Observation and assistance in real PTMC procedures. Practice transseptal puncture on simulators or models. Hemodynamic pressure recording during cardiac catheterization.		P2		Demo		OSPE/OSCE	02
76		SOPs Compliance	Adopt how to Prepare PTMC balloon, transseptal set, hemodynamic monitoring in Cath lab. Ensure absence of LA thrombus via TEE and adopt how to prepare and pass balloon catheter to cardiologist for inflation at mitral valve.			A4				
TOPIC: CHRONIC TOTAL OCCLUSION										
77	Week-16	Definition	Define chronic total occlusion	C1			Interactive Lecture/SDG			05
78		Indication	Explain indication for revascularization for CTO	C2						
79		Procedure fundamentals and Techniques of CTO crossing	Explain Procedure fundamentals and Techniques of CTO crossing (antegrade wire escalation, antegrade dissection/re-entry, retrograde approach)	C2						
80		Equipment used in CTO interventions and imaging techniques	Explain Equipment used in CTO interventions (guide wires, microcatheters, re-entry devices) and imaging techniques (IVUS)	C3						
		Complications and management	Explain Complications and management of CTO lesions	C3						
82		Practical	Adopts hands-on training on CTO guidewires and microcatheters. Observation and participation in real CTO PCI cases and assisting in catheter preparation and imaging during CTO PCI.		P4		Demo		OSPE/OSCE	01
83		SOPs Compliance	Comply SOPs for preparing CTO-specific wires, catheters according to operator preference.			A2	Role Play			

Recommended Books:
1. Practical Handbook of Advanced Interventional Cardiology by Thach Nguyen. 4Th edition Wiley & Sons, Ltd., Publication.
2. Cardiovascular Catheterization and intervention by Debrata Mukherjee,2ND Edition.
3. The interventional cardiac Catheterization Handbook by Morton J. Kern, MD.

ASSESSMENT BREAKDOWN				
S. No	**Topics**	**No of MCQ**	**No of OSPE / OSCE Stations**	**Static / Interactive**
1	An introduction to Interventional Cardiology	3	1	Interactive
2	Radiations safety	3	1	Static and Interactive
3	Contrast media and Patient selection,	4	0	
4	Vasopressors, Vasodilators and anti thrombotics in the Catherization laboratory	5	1	Interactive
5	Hemodynamic assessment	4	1	Static and Interactive
6	Various sites of vascular access	4	1	Static and Interactive
7	Angiographic views and Coronary angiographic assessment	4	1	Statistic
8	Practical analysis of guide design of catheters	5	1	Interactive
9	Guide wires	5	1	Interactive
10	Angioplasty Balloon	5	1	Static and Interactive
11	Stents	7	1	Static and Interactive
12	Left main coronary artery procedures	6	1	Statistic
13	Ostial lesions	5	1	Statistic
14	Primary percutaneous coronary intervention in ST segment elevation in myocardial infarction (STEMI)	5	1	Static and Interactive
15	PTMC	5	1	Static and Interactive
16	Chronic total occlusion	5	0	Nil
Total	**16**	**70**	**14**	**14**

CARDIAC PERFUSION CP-604
VENTRICULAR ASSISTANCE DEVICES
3(2+1)

Course Description:

This course explores the design, function, and clinical application of Ventricular Assist Devices (VADs) used for mechanical circulatory support in patients with end stage heart failure. Students will learn about different types of VADs, including Left, Right, and Bi-Ventricular Assist Devices, their indications, contraindications, surgical implantation techniques, and post-operative management. The course includes discussions on patient selection, anticoagulation protocols, device troubleshooting, and long-term care strategies. Emphasis is placed on current trends, clinical guidelines, and multidisciplinary collaboration in VAD patient care.

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Define mechanical circulatory support (MCS) and differentiate between short-term and long-term devices.
2. Explain the indications, contraindications, and patient selection criteria for VAD therapy.
3. Describe the basic principles of ventricular assist devices (VADs), percutaneous circulatory assist devices, and intra-aortic balloon pump (IABP).
4. Explain the role of echocardiography in assessing VAD function and detecting complications.
5. Identify common complications of VADs, including thrombosis, bleeding, right ventricular failure, and infections.
6. Discuss the perioperative and postoperative management of patients on VAD support.
7. Explain the process of weaning off mechanical circulatory support and transitioning to recovery or transplantation.
8. Describe the role of VADs in bridging patients to cardiac transplantation and post-transplant care.
9. Explain the principles of community-based management of VAD patients, including outpatient care and emergency planning.
10. Discuss the basic troubleshooting techniques for common VAD and IABP malfunctions

Psychomotor Domain:

By the end of this course, students should be able to:

1. Identify the key components of short-term and long-term mechanical circulatory support devices.
2. Observe and summarize the steps involved in patient preparation, implantation, and management of VADs.Recognize echocardiographic and hemodynamic signs of normal and abnormal VAD function.
3. Demonstrate basic troubleshooting techniques for mechanical circulatory support devices under supervision.
4. Assist in the basic care and monitoring of patients on VAD support in a clinical or simulated setting.

Affective Domain:

By the end of this course, students should be able to:

1. Recognize the importance of mechanical circulatory support in managing critically ill cardiac patients.
2. Demonstrate a professional and ethical approach when handling patients with VADs.
3. Value the role of teamwork and interdisciplinary collaboration in managing patients on mechanical circulatory support.
4. Appreciate the impact of MCS devices on patients' quality of life and long-term outcomes.
5. Show responsibility in continuous learning and adaptation to advancements in circulatory support technology.

Table of Specification

VENTRICULAR ASSISTANCE DEVICES

S. No	Weeks	Content	Learning Outcome	Domain			MIT's	Time/ Hours	Assessment	No of Items
				C	P	A				
TOPIC: Introduction to Short and Long Term Mechanical Circulatory Support Devices and Its Indication										
1	Week-1	Introduction	Define mechanical circulatory support (MCS) and differentiate between short-term and long-term ventricular assist devices (VADs).	C1			Interactive Lecture, SGD	2 hours	MCQs, SEQs	7
2		Indications	List the common indications for MCS, including bridge to transplant, bridge to recovery, and destination therapy.	C1						
3		Practical	Identify the key components of a ventricular assist device in a clinical or lab setting.		P2		Demo, Videos	1 hour	OSCE	
4			Appreciate the impact of emerging technologies in improving patient care and outcomes.			A2	Role Play			
TOPIC: Echocardiographic Evaluation of Ventricular Assistance Devices										
5	Week-2 & Week-3	Assessment	Define the role of echocardiography in the assessment and management of patients with ventricular assist devices (VADs).	C1			Interactive Lecture, SGD	2 hours	MCQs, SEQs	6
6		Modalities	List the key echocardiographic modalities used for VAD evaluation, including transthoracic (TTE), transesophageal (TEE), intracardiac, and contrast echocardiography.	C1						
7		Complications	Describe the echocardiographic features of normal VAD function and common complications such as thrombosis, inflow/outflow obstruction, and pericardial effusion.	C2			Interactive Lecture, SGD	2 hours	MCQs, SEQs	
8		Insertion	Explain how echocardiography is used in VAD placement, including cannula positioning and de-airing.	C3						
9		Practical	Demonstrate the ability to interpret basic echocardiographic findings related to VAD function in a simulated setting.		P3		Demo, Videos	1 hour	OSCE	
10			Value the role of echocardiography in early detection of VAD complications, improving patient outcomes.			A2	Role Play			
TOPIC: Ventricular Assistance for Post cardiotomy Cardiogenic Shock										
11	Week-4 Week-5	Patient selection	List the criteria for patient selection for ventricular assist devices (VADs) in Post Cardiotomy Cardiogenic Shock (PCCS).	C1			Interactive Lecture, SGD	2 hours	MCQs, SEQs	10
12		Preparation	Describe the steps involved in preoperative preparation before VAD implantation.	C2						
13		Perioperative management	Explain the perioperative management strategies to optimize patient outcomes	C3						
14		Postoperative management	List the common complications following VAD implantation (e.g., bleeding, infection, right ventricular failure, thrombosis).	C2						
15		Weaning and Device Removal	Discuss the indications and protocols for weaning from mechanical circulatory support	C3			Interactive Lecture,	2 hours	MCQs,	

16	Week-6	Patient Care Following Ventricular Assist Device Removal	Describe the management of patients following VAD removal, including complications and recovery	C4			SGD		SEQs	
17		Practical	Observe and summarize the patient preparation process for VAD implantation.		P2		Demo, Videos	1 hour	OSCE	
18			Value teamwork and interdisciplinary collaboration in the perioperative and postoperative management of PCCS patients.			A2	Role Play			
TOPIC: Ventricular Assistance as a Bridge to Cardiac Transplantation										
19	Week-7 To Week-9	Role	Define the role of ventricular assist devices (VADs) as a bridge to cardiac transplantation	C1			Interactive Lecture, SGD	2 hours	MCQs, SEQs	10
20		Patient selection	List the criteria for patient selection for VAD implantation before transplantation	C1						
21		Primary management	Identify the primary management goals for patients requiring a VAD before transplant	C2						
22		Preoperative management	Describe the preoperative preparation process for a patient receiving a VAD	C2						
23		VADs selection	Recognize the different types of VADs used in bridging to cardiac transplantation	C2						
24		Perioperative management	Explain the basic principles of perioperative management in VAD-supported patients	C2						
25		Preparation for Cardiac Transplantation	Describe the steps involved in preparing a patient for cardiac transplantation.	C3						
26		Transplantation	Outline the key phases of cardiac transplantation surgery	C3						
27		Post-op Complications	Identify common post-transplant complications and their management strategies.	C3						
28		Post-op patient care and management	Explain the basic principles of post-transplant patient care, including immunosuppression and rehabilitation.	C3						
29		Practical	Identify key preoperative and postoperative monitoring parameters in VAD-supported transplant patients		P1		Demo, Videos	1 hour	OSCE	
30			Recognize echocardiographic and hemodynamic signs indicating the need for a VAD in transplant candidates		P2					
31			Appreciate the need for continuous learning and adaptation in the evolving field of mechanical circulatory support.			A2	Role Play			
TOPIC: Complications of Ventricular Assistance Devices										
32	Week-10 Week-11	Common complications	Identify the common complications of VADs, including early and late complications	C2			Interactive Lecture, SGD	2 hours	MCQs, SEQs	10
33		Early complications	List the early complications of VADs, such as inadequate LVAD flow, right ventricular dysfunction, hemorrhage, and thromboembolism	C1						
34		Late complication	Describe the late complications of VADs, including thromboembolism, infection, multisystem organ failure, and pump dependency	C2						
35		Monitoring	Discuss the diagnostic techniques used to identify VAD-related complications, including imaging and hemodynamic monitoring	C3						

36		Practical	Identify early signs of VAD complications in simulated case studies or clinical settings		P1		Demo, Videos	1 hour	OSCE	
			Recognize hemodynamic and echocardiographic abnormalities indicative of VAD dysfunction.		P3					
27			Recognize the importance of early detection and intervention in VAD complications.			A1	Role Play			
TOPIC: Role for Percutaneous Circulatory Assistance Devices										
37	Week-12	Introduction	Define percutaneous circulatory assistance devices and their role in acute cardiac collapse	C1			Interactive Lecture, SGD	2 hours	MCQs, SEQs	10
38		Types (PVADs)	List the types of percutaneous circulatory assist devices, including Impella and Tandem Heart	C1						
39		Indications	Describe the indications for percutaneous circulatory support, such as cardiogenic shock and high-risk PCI	C2						
40		Principle	Explain the basic principles of device function, including blood flow mechanics and hemodynamic effects	C2						
41		Future perspective (Advantages & Limitations)	Compare the advantages and limitations of percutaneous VADs versus surgically implanted VADs	C3						
42		Complications	Discuss the potential complications of percutaneous circulatory support, such as vascular injury, bleeding, and thrombosis	C3						
43		Practical	Identify the key components of a percutaneous circulatory assist device in a lab or clinical setting		P1		Demo, Videos	1 hour	OSCE	
			Recognize hemodynamic changes on monitoring devices in patients receiving percutaneous support		P2					
44		SOPs	Recognize the importance of early intervention with percutaneous circulatory support in acute cardiac failure.			A1	Role Play			
TOPIC: Community Based Management of VADs										
45	Week-13	Introduction	Define the role of community-based management in the care of VAD patients	C1S			Interactive Lecture, SGD	2 hours	MCQs, SEQs	7
46		Hospital discharge preparation	List the key components of a successful VAD discharge program, including patient education, caregiver training, and emergency planning	C1						
47		Community support	Describe the requirements for patient readiness for hospital discharge, including physical and psychological factors	C2						
48		Outpatient follow-up	Explain the role of outpatient follow-up care, including routine clinic visits, medication adjustments, and echocardiographic monitoring	C2						
49		Outpatient LVAD outcomes	Discuss the common challenges faced by VAD patients in the community, such as device malfunction, infections, and access to medical care	C3						
50		Outpatient medical management	Explain the coordination between local healthcare providers and VAD centers for emergency and routine care	C3						
51		Practical	Identify the basic steps involved in VAD patient discharge planning, including caregiver training and patient self-care		P1		Demo, Videos	1 hour	OSCE	
52		SOPs	Recognize the importance of community-based care in improving VAD patient outcomes.			A1	Role Play			
TOPIC: Intra-aortic balloon pump										
53		Definition	Define the function and purpose of an intra-aortic balloon pump (IABP) in circulatory support.	C1			Interactive Lecture, SGD	2 hours	MCQs, SEQs	10
54		Indications Contraindications	List the indications and contraindications for IABP therapy.	C1						

55	Week-14 To Week 16	Working Principle	Describe the principle of counter pulsation and how it improves coronary perfusion and reduces afterload.	C2						
		Components	Explain the basic components of an IABP system, including the console, catheter, and helium gas mechanism.	C2						
55		Triggers	Discuss the different triggering modes of IABP (ECG, arterial pressure trigger) and their clinical applications.	C3						
56		Hemodynamics outcomes	Identify the hemodynamic effects of IABP therapy, including its impact on cardiac output, diastolic augmentation, and systemic vascular resistance	C3						
57		Complications	Describe the potential complications of IABP therapy, such as limb ischemia, balloon rupture, and catheter malposition.	C3						
58		Timing errors	Explain common timing errors in IABP function, such as early inflation, late inflation, early deflation, and late deflation, and their effects on cardiac performance.	C4						
59		Trouble shooting	Identify troubleshooting techniques for common IABP alarms and malfunctions, including gas leaks, console errors, and catheter kinking.	C4						
60		Weaning	Discuss the criteria for weaning a patient off IABP support, including gradual reduction of balloon assist ratio and monitoring hemodynamic stability.	C4						
61		Alternative therapy	Evaluate alternative mechanical circulatory support options when IABP is ineffective or contraindicated.	C5						
62		Practical	Identify the key components of an IABP console and catheter system in a clinical or lab setting.		P1		Demo, Videos	1 hour	OSCE	
			Recognize proper timing of IABP inflation and deflation on arterial waveforms in simulated or clinical settings.		P2					
62			Appreciate the need for continuous learning and technological updates in mechanical circulatory support devices like IABP.			A3	Demo, Videos			

Recommended Books:
1. Ventricular Assist Devices By: Dr. Jeffrey Shuhaiber
2. Mechanical Circulatory support by Wayne E. Rickenbacker
3. The Manual of Clinical Perfusion by Bryan V. Lich and D. Marj Brown 2nd edition

ASSESSMENT BREAKDOWN				
S. No	**Topics**	**No of MCQ**	**No of OSPE / OSCE Stations**	**Static / Interactive**
1	Introduction to Short and Long Term Mechanical Circulatory Support Devices and Its Indication	7	1	Static
2	Echocardiographic Evaluation of Ventricular Assistance Devices	6	1	Static
3	Ventricular Assistance for Post cardiotomy Cardiogenic Shock	10	2	Static
4	Ventricular Assistance as a Bridge to Cardiac Transplantation	10	2	Static
5	Complications of Ventricular Assistance Devices	10	2	Static / Interactive
6	Role for Percutaneous Circulatory Assistance Devices	10	2	Static / Interactive
7	Community Based Management of VADs	7	1	Static / Interactive
8	Intra-aortic balloon pump	10	3	Static / Interactive
Total	**8**	**70**	**14**	**14**

CARDIAC PERFUSION – CP-604
PERFUSION TECHNOLOGY - I 3(2+1)

Course Description:

Perfusion Technology I introduce students to the foundational principles of extracorporeal circulation. The course covers the history, evolution, and roles of the clinical perfusionist, with emphasis on cardiopulmonary bypass (CPB) circuits, components, and basic operational protocols. Topics include perfusion physiology, blood handling, hemodilution, anticoagulation, oxygenation systems, heat exchange, priming techniques, and safety monitoring. Laboratory sessions reinforce theoretical knowledge through hands-on experience with circuit assembly, priming, and basic troubleshooting. This course lays the groundwork for advanced perfusion techniques taught in subsequent semesters.

Learning Objectives:

Cognitive Domain:

By the end of this course, students should be able to:

1. Define the principles and components of Cardiopulmonary Bypass (CPB).
2. Explain the function and operation of the Heart-Lung Machine, Oxygenator, and Heater-Cooler.
3. Describe the process of CPB setup, safety checks, and priming techniques.
4. Compare different anticoagulation strategies and coagulation monitoring techniques.
5. Evaluate metabolic and hemodynamic parameters to ensure optimal CPB management.

Psychomotor Domain:

By the end of this course, students should be able to:

1. Set up and perform pre-bypass safety checks on CPB equipment and circuit components.
2. Monitor and interpret hemodynamic and metabolic parameters during CPB and weaning.
3. Adjust anticoagulation levels based on ACT, PT-INR, and Thromboelastographic (TEG) results.
4. Perform correct cannulation techniques (arterial/venous) and circuit connections.
5. Administer appropriate interventions for coagulopathies, metabolic imbalances, and perfusion adjustments.

Affective Domain:

By the end of this course, students should be able to:

1. Demonstrate responsibility and precision in performing CPB-related procedures.
2. Appreciate the importance of blood conservation techniques in reducing transfusion-related risks.
3. Commit to ensuring patient safety by following AmSECT/EBCP guidelines for CPB monitoring.
4. Respect the role of multidisciplinary teamwork in effective CPB management and weaning.
5. Recognize the ethical considerations involved in blood management and patient care.

Table of Specifications

PERFUSION TECHNOLOGY-I

S. No	Weeks	Content	Learning Outcome	Domain			MIT's	Time/ Hours	Assessment	No of Items
				C	P	A				
TOPIC: INTRODUCTION TO CARDIOPULMONARY BYPASS, EQUIPMENT'S AND CIRCUIT										
1	Week-1	Introduction	Define cardiopulmonary bypass (CPB) and its role in cardiac surgery.	C1			Interactive Lecture SGDs	2	MCQs SEQs	12
2		Tubing	Describe the materials, characteristics, and sizing of CPB tubing.	C2						
			Compare different types of tubing and their impact on hemodynamics and biocompatibility.	C4						
3		Arterial and Venous Cannulas	Identify the types of arterial and venous cannulas and their specific uses in CPB.	C1						
			Explain the selection criteria for cannula size and insertion sites.	C2						
4		Perfusion Pumps	Differentiate between roller and centrifugal pumps based on mechanism and clinical applications.	C4						
			Discuss the impact of pump flow on patient hemodynamics.	C2						
5		Reservoir	Describe the function of venous and cardiotomy reservoirs in CPB circuits.	C2						
6		Oxygenator	Compare membrane vs. bubble oxygenators in terms of efficiency and safety.	C4						
			Explain the working principle of membrane oxygenators.	C2						
7		Heat Exchanger	Describe the role of heat exchangers in temperature management during CPB.	C2						
8		Gas Supply System	Explain the function of gas supply systems in regulating oxygen and carbon dioxide levels.	C2						
9		Filter and Bubble Traps	Discuss the importance of arterial line filters and bubble traps in preventing embolism.	C2						
10	Week-2	Sucker and Vent	Describe the function of suckers and vents in CPB and cardiac suction management.	C2						
11		Cardioplegia Delivery System	Explain the principle of cardioplegia delivery for myocardial protection.	C2						
			Compare blood and crystalloid cardioplegia solutions.	C4						
12		Hemofilter	Describe the function of hemofilters in fluid management and ultrafiltration during CPB.	C2						
13		Practical	Identify and correctly assemble components of the CPB circuit under supervision.		P2		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Operate the perfusion pumps, adjusting flow rates and monitoring pressure changes effectively (under supervision).		P4					
14			Demonstrate responsibility in handling CPB equipment with care and adherence to safety protocols.			A3	Role Play			

TOPIC: PRINCIPLES AND OPERATION OF THREE KEY COMPONENTS OF CARDIOPULMONARY BYPASS										
15	Week-3	Heart-Lung Machine	Define the heart-lung machine and its role in cardiopulmonary bypass.	C1			Interactive Lecture SGDs	2	MCQs SEQs	04
			Describe the working principles of the heart-lung machine, including blood flow regulation and pressure monitoring.	C2						
			Explain the components of the heart-lung machine, including pumps, reservoirs, and control systems.	C2						
16		Oxygenator	Describe the function and types of oxygenators used in CPB.	C2						
			Explain the mechanism of gas exchange in membrane oxygenators.	C2						
			Compare membrane oxygenators with bubble oxygenators in terms of efficiency and safety.	C4						
			Analyze factors affecting oxygenator performance, including temperature, blood flow, and gas exchange efficiency.	C4						
17		Heater Cooler	Describe the function of the heater-cooler unit in temperature regulation during CPB.	C2						
			Explain the effects of hypothermia and rewarming on patient metabolism and circulation.	C2						
18		Practical	Identify and assemble the key components of the heart-lung machine. (under supervision)		P2		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Demonstrate the setup and priming of the HLM before bypass initiation. (under supervision)		P3					
			Prepare the oxygenator, ensuring proper gas flow and blood flow parameters. (under supervision)		P3					
			Set up and calibrate the heater-cooler unit based on surgical requirements. (under supervision)		P3					
19			Demonstrate responsibility in maintaining and handling the heart-lung machine, oxygenator, and heater-cooler unit.			A3	Role Play			
TOPIC: CARDIOPULMONARY BYPASS MONITORING										
20	Week-4	General Monitoring	Define cardiopulmonary bypass (CPB) monitoring and its significance in patient safety.	C1			Interactive Lecture SGDs	2	MCQs SEQs	03
			Describe the key physiological parameters monitored during CPB (e.g., arterial pressure, venous return, oxygenation, perfusion flow).	C2						
21		Am SECT and EBCP Guidelines	Summarize the American Society of Extracorporeal Technology (Am SECT) and European Board of Cardiovascular Perfusion (EBCP) guidelines for CPB monitoring.	C2						
			Compare Am SECT and EBCP recommendations on perfusion safety, anticoagulation, and hemodynamic management.	C2						
22		Practical	Identify key monitoring equipment, including pressure transducers, blood gas analyzers, and coagulation monitors.		P2		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Set up and calibrate monitoring devices before initiating CPB.		P3					
23			Demonstrate vigilance and attention to detail in monitoring CPB parameters.			A3	Role Play			
TOPIC: CARDIOPULMONARY BYPASS SETUP AND SAFETY CHECKS										
24		CPB Setup	Describe the step-by-step assembly of the CPB circuit, including tubing connections, oxygenator placement, and reservoir positioning.	C2			Interactive Lecture	2	MCQs SEQs	04

25	Week-5	Pre-CPB Safety Checklist	List the essential pre-CPB safety checks required before initiating bypass.	C1			SGDs			
26		Emergency Supply of Safety Devices and Equipment	Identify critical emergency equipment required for CPB (e.g., backup oxygenators, hand-crank pumps, arterial filters).	C1						
27		Practical (under supervision)	Verify all circuit connections and test for leaks before initiating bypass.		P3		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Conduct a comprehensive pre-CPB safety checklist, including anticoagulation verification and equipment readiness.		P3					
			Locate and prepare emergency safety equipment, including hand-crank backup systems and spare oxygenators.		P2					
28			Demonstrate a sense of responsibility in conducting thorough safety checks before CPB initiation.			A3	Role Play			
TOPIC: PRIMING										
29	Week-6	Principle of Priming	Explain the concept of hemodilution and its impact on perfusion.	C2			Interactive Lecture SGDs	2	MCQs SEQs	05
30		Types of Priming	Compare different types of priming solutions in terms of composition and physiological effects.	C4						
31		Autologous versus Homologous priming	Differentiate between autologous and homologous priming techniques.	C4						
			Describe the process and benefits of autologous priming.	C2						
32		Retrograde Autologous Priming	Explain the principles of retrograde autologous priming (RAP) and its role in reducing hemodilution.	C2						
33		Venous Autologous Priming	Describe the technique and advantages of venous autologous priming (VAP).	C2						
34		Crystalloid versus Colloid priming	Compare crystalloid priming and colloid priming, highlighting their effects on plasma oncotic pressure.	C4						
			Discuss the indications and contraindications for using crystalloid vs. colloid priming.	C2						
35		Prime Additives	Identify commonly used prime additives (e.g., heparin, bicarbonate, calcium, mannitol).	C1						
36		Osmolarity and Formulas	Explain the role of osmolarity in maintaining fluid balance in CPB.	C2						
			Calculate volume concentration formula to determine the dilution effect of priming solutions.	C3						
			Describe Allen's formula and its application in estimating hemodilution.	C2						
37		Practical	Prepare and assemble the CPB circuit for priming.		P2		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Calculate volume concentration formula to determine final hematocrit after priming.		P3					
			Apply Allen's formula to assess expected hemodilution before CPB initiation		P3					
38			Demonstrate attention to detail when selecting and preparing priming solutions.			A3	Role Play			
TOPIC: COAGULATION, ANTICOAGULATION AND COAGULATION TESTING										
39		Clotting Factors	List the clotting factors involved in the coagulation cascade.	C1			Interactive Lecture	2	MCQs SEQs	04
40		Intrinsic and Extrinsic Pathway	Describe the intrinsic and extrinsic pathways of coagulation.	C2						

41	Week-7	Heparin	Describe the mechanism of action of heparin in anticoagulation.	C2			SGDs			
42		Protamine	Explain the reversal of heparin with protamine sulfate and its potential side effects.	C2						
43		Alternatives in Heparin Induces Thrombocytopenia	Discuss the alternatives to heparin in cases of heparin-induced thrombocytopenia (HIT), such as bivalirudin, argatroban, and fondaparinux.	C2						
44		Coagulation Testing	Define coagulation testing and its importance in monitoring anticoagulation.	C1						
45		Activated Clotting Time (ACT)	Describe the Activated Clotting Time (ACT) and its role in CPB management.	C2						
46		Prothrombin Time (PT) and International Normalized Ratio (INR)	Explain the Prothrombin Time (PT) and International Normalized Ratio (INR) and their relevance in anticoagulation therapy.	C2						
47		Activated Partial Thromboplastin Time (aPTT)	Describe the Activated Partial Thromboplastin Time (aPTT) and its use in heparin monitoring.	C2						
48		Viscoelastic Testing (VET Thromboelastographic (TEG)	Explain Viscoelastic Testing (VET), including Thromboelastographic (TEG), and its role in real-time coagulation assessment.	C2						
			Compare ACT, PT-INR, aPTT, VET, and TEG in terms of clinical applications and limitations.	C4						
49		Practical	Identify clotting factors and their roles in the coagulation cascade.		P2		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Perform ACT testing before, during, and after CPB.		P3					
50			Demonstrate a commitment to ensuring safe and effective anticoagulation management in CPB.			A3	Role Play			
TOPIC: COAGULOPATHIES AND HEMATOLOGICAL DISORDERS										
51	Week-8	Coagulopathies Hematological disorders	Define coagulopathies and hematological disorders and their impact on perfusion management.	C1			Interactive Lecture SGDs	2	MCQs SEQs	04
52		Sickle Cell Anemia	Describe the genetic basis, pathophysiology, and clinical manifestations of sickle cell anemia.	C2						
53		Cold Agglutination	Explain the effects of cold agglutination on red blood cells and its implications in hypothermia during CPB.	C2						
54		Polycythemia	Discuss the causes and risks associated with polycythemia, including its impact on blood viscosity and perfusion.	C2						
55		Thalassemia	Explain the types, causes, and complications of thalassemia.	C2						
56		Platelets Disorder	Describe the function of platelets and disorders affecting their quantity and function.	C2						
57		Von Willebrand Disease (vWD)	Explain the role of von Willebrand factor and the implications of von Willebrand disease (vWD) on hemostasis.	C2						
58		Hemophilia	Differentiate between hemophilia A and B, their genetic basis, and management strategies.	C4						
59		Disseminated Intravascular Coagulation (DIC)	Describe the mechanisms and complications of disseminated intravascular coagulation (DIC).	C2						
60		Heparin-Induced Thrombocytopenia (HIT	Explain heparin-induced thrombocytopenia (HIT), including its immune-mediated mechanism and alternative anticoagulation options.	C2						
61		Practical	Administer appropriate blood products (e.g., platelets, cryoprecipitate, fresh frozen plasma) in patients with coagulopathies.		P3		Clinical Rotations Demo	1	OSPE OSCE	

							Videos			
62			Demonstrate empathy and ethical consideration in managing patients with hematological disorders.			A3				
TOPIC: BLOOD CONSERVATION TECHNIQUES										
63		Hemoconcentrator	Describe the working principle of hemoconcentrator in removing excess plasma water while retaining blood cells.	C2			Interactive Lecture SGDs	2	MCQs SEQs	04
			Explain the impact of hemoconcentration on hematocrit, electrolyte balance, and plasma volume.	C2						
64		Autologous Blood Transfusion	Define autologous blood transfusion and its different types.	C1						
			Explain the concept of acute normovolemic hemodilution (ANH) and its role in reducing allogeneic transfusion.	C2						
65		Cell Salvage	Describe the principle of cell salvage in recovering shed blood during surgery.	C2						
			Explain the process of washing, filtering, and reinfusing salvaged blood.	C2						
66	Week-9 Week-10	Plasmapheresis	Define plasmapheresis and its role in removing harmful substances from blood.	C1						
			Describe the indications for plasmapheresis in CPB and critical care settings.	C2						
67		Practical	Set up and operate a hemoconcentrator in a CPB circuit. (under supervision)		P3		Clinical Rotations Demo Videos	1	OSPE OSCE	
68			Demonstrate a commitment to reducing unnecessary blood transfusions.			A3				
TOPIC: BASIC FORMULAS IN CPB										
69	Week-11	Body Surface Area (BSA)	Define Body Surface Area (BSA) and its clinical significance in CPB (Mosteller formula).	C1			Interactive Lecture SGDs	2	MCQs SEQs	03
70		Body Mass Index (BMI	Define Body Mass Index (BMI) and its importance in patient assessment.	C1						
71		Cardiac Output (CO)	Define Cardiac Output (CO) and its role in systemic circulation.	C1						
		Cardiac Index (CI)	Define Cardiac Index (CI) and its clinical significance.	C1						
		Perfusion Blood Flow	Define perfusion blood flow and its importance in CPB.	C1						
			Analyze how changes in perfusion flow rates affect oxygen delivery and organ perfusion.	C4						
72		Practical	Calculate BSA, BMI, CO, CI, and perfusion blood flow using standard formulas.		P3		Clinical Rotations Demo Videos	1	OSPE OSCE	
73			Demonstrate precision and attention to detail in performing perfusion calculations.			A3	Role Play			
TOPIC: CONDUCT OF CARDIOPULMONARY BYPASS										
74		Arterial Cannulation	Define central and peripheral arterial cannulation and their indications.	C1			Interactive Lecture SGDs	2	MCQs SEQs	05
75		Venous Cannulation	Describe central and peripheral venous cannulation techniques.	C2						

76	Week-12		Compare the advantages and limitations of central vs. peripheral cannulation.	C4						
77		CPB Circuit Connection & Initiation	Describe the sequence of connecting the CPB circuit to the patient.	C2						
			Explain the importance of de-airing the circuit before initiating bypass.	C2						
			Outline the steps for the initiation of CPB, including achieving full flow.	C3						
78		Venous Drainage & Cardiopulmonary Support	Define Vacuum-Assisted Venous Drainage (VAVD) and its role in CPB.	C1						
			Explain the advantages and risks associated with VAVD.	C2						
			Describe the role of cardiotomy suction and heart venting in preventing blood stasis.	C2						
79		Temperature Management	Explain the rationale for cooling and rewarming during CPB.	C2						
			Describe the effects of hypothermia and hyperthermia on metabolism and oxygen consumption.	C2						
			Analyze the physiological response to different cooling and rewarming rates.	C4						
80		Monitoring During CPB	List the key physiological parameters monitored during CPB (e.g., arterial pressure, venous saturation, hematocrit).	C1						
			Explain the importance of monitoring arterial blood gases (ABG), activated clotting time (ACT), and perfusion pressures.	C2						
			Evaluate the implications of abnormal CPB monitoring values and corrective measures.	C5						
81		Practical	Connect the CPB circuit and ensure proper priming and de-airing.		P3		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Monitor key CPB parameters, including perfusion flow, pressures, and oxygenation.		P3					
			Adjust perfusion settings based on patient parameters (e.g., flow rate, temperature, oxygenation).		P4					
82			Demonstrate attentiveness to detail in monitoring and troubleshooting CPB parameters.			A3	Role Play			
TOPIC: MYOCARDIAL PRESERVATION										
83	Week-13	Cardioplegia Physiology	Define cardioplegia and its role in myocardial protection.	C1			Interactive Lecture SGDs	2	MCQs SEQs	07
			Describe the physiological effects of cardioplegia on the myocardium, including depolarization, repolarization, and energy conservation.	C2						
			Compare different cardioplegia strategies (e.g., antegrade vs. retrograde, crystalloid vs. blood-based).	C4						
84		Cardioplegia Solutions & Additives	List the types of cardioplegia solutions (crystalloid and blood cardioplegia).	C1						
			Explain the composition of commonly used cardioplegia solutions, including potassium, magnesium, bicarbonate, and calcium.	C2						
			Analyze the role of cardioplegia additives (e.g., lidocaine, glutamate, aspartate, mannitol) in myocardial protection	C4						

85		Cardioplegia Delivery Techniques	Describe the different delivery routes of cardioplegia (antegrade, retrograde, integrated).	C2						
			Explain the advantages and limitations of intermittent vs. continuous cardioplegia delivery.	C2						
			Compare cold and warm cardioplegia in terms of myocardial protection and metabolic effects.	C4						
86		Non-Cardioplegic Methods of Myocardial Protection	Define non-cardioplegic methods of myocardial protection.	C1						
			Explain techniques such as systemic hypothermia, ischemic preconditioning, and pharmacologic preconditioning.	C2						
			Analyze the effectiveness of cardioplegic vs. non-cardioplegic myocardial preservation strategies.	C4						
87		Practical	Administer cardioplegia using the appropriate temperature, volume, and pressure settings. (under supervision)		P4		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Monitor myocardial protection parameters, including temperature, electrocardiogram (ECG) activity, and metabolic markers.		P3					
			Identify signs of inadequate myocardial protection (e.g., ST changes, lactate buildup)		P4					
88			Appreciate the importance of selecting appropriate cardioplegia strategies based on patient condition.			A3	Role Play			
TOPIC: METABOLIC MANAGEMENT DURING CPB										
89	Week-14	Perfusion Parameters	Define CPB blood flow and its role in maintaining adequate tissue perfusion.	C1			Interactive Lecture SGDs	2	MCQs SEQs	10
			Calculate appropriate CPB blood flow based on cardiac index (CI) and body surface area (BSA).	C3						
			Explain the significance of maintaining an optimal mean arterial pressure (MAP) during CPB.	C2						
90		Blood Gas Parameters & Acid-Base Balance	List key blood gas parameters (PaO_2, $PaCO_2$, pH, HCO_3^-) monitored during CPB.	C1						
			Differentiate between alpha-stat and pH-stat strategies for acid-base management.	C4						
			Explain the consequences of acidosis and alkalosis on organ perfusion and oxygen delivery.	C2						
91		Hematological & Oxygenation Parameters	Define hematocrit (Hct) and its role in oxygen-carrying capacity during CPB.	C1						
			Interpret mixed venous oxygen saturation (SvO_2) and its significance in assessing tissue oxygenation.	C4						
			Describe the clinical implications of low SvO_2 and how to optimize oxygen delivery.	C2						
92	Week-15	Goal-Directed Perfusion & Metabolic Monitoring	Explain the concept of goal-directed perfusion and its importance in CPB.	C2						
			Analyze the role of urine output and blood lactate levels as indicators of perfusion adequacy.	C4						
			Evaluate strategies to optimize perfusion based on metabolic markers.	C5						
		Electrolyte & Drug Metabolism	List the essential electrolytes (Na^+, K^+, Ca^{2+}, Mg^{2+}) regulated during CPB.	C1						
			Describe the effects of electrolyte imbalances on cardiac and systemic function.	C2						
93			Explain how CPB alters drug metabolism, including the impact of hemodilution and hypothermia. (C2 - Understanding)	C2						

		Practical	Measure and monitor key metabolic parameters, including blood gases, hematocrit, SvO_2, urine output, and lactate levels.		P3		Clinical Rotations Demo Videos	1	OSPE OSCE	
			Calibrate and operate blood gas analyzers to assess acid-base balance and oxygenation.		P3					
94			Recognize the importance of maintaining optimal metabolic conditions for patient safety.			A3				
95										
TOPIC: WEANING FROM CARDIOPULMONARY BYPASS										
96	Week-16	CPB Termination Checklist	List the key parameters assessed before CPB termination (e.g., temperature, blood pressure, heart rate, and rhythm).	C1			Interactive Lecture SGDs	2	MCQs SEQs	05
			Explain the importance of achieving a target temperature before weaning.	C2						
			Discuss the role of target blood pressure and perfusion adequacy before CPB termination.	C2						
		Cardiac Function & Hemodynamic Stability	Explain the role of reperfusion, rate, and rhythm in restoring myocardial function.	C2						
97			Describe the process of deairing and its importance in preventing air embolism.	C2						
			Compare different pacing strategies for restoring normal heart function post-CPB.	C4						
98		Metabolic & Blood Parameter Optimization	List key metabolic and hematological parameters monitored before CPB termination (electrolyte balance, acid-base balance, hemoglobin levels, volume status).	C1						
			Analyze blood gas values to determine readiness for weaning.	C4						
			Interpret the role of transesophageal echocardiography (TEE) in confirming cardiac function post-CPB.	C4						
100		Pharmacologic & Mechanical Support	Explain the role of inotropic agents (e.g., epinephrine, dopamine, dobutamine) in myocardial support.	C2						
			Evaluate the need for mechanical circulatory support (e.g., intra-aortic balloon pump (IABP), extracorporeal membrane oxygenation (ECMO)) in difficult weaning situations	C5						
			Discuss strategies to optimize cardiac output and tissue perfusion during weaning.	C2						
101		Practical	Monitor hemodynamic parameters (heart rate, blood pressure, cardiac output) to assess readiness for CPB termination.		P3		Clinical Rotations Demo Videos	1	OSPE OSCE	
102			Demonstrate a responsible and systematic approach to weaning from CPB.			A3				

Recommended Books:
1. The Manual of Clinical Perfusion by Bryan V. Lich and D. Marj Brown, 2nd edition
2. Cardiopulmonary Bypass and Mechanical Support Principles and Practice, 4th edition by Glenn P. Gravlee, MD.
3. Cardiopulmonary Bypass Principles and Techniques by Mohammad Ibrahim Barhams.
4. Cardiopulmonary Bypass by Florian Falter, Albert C Perrino, and Robert A Baker, 3rd Edition

ASSESSMENT BREAKDOWN				
S. No	**Topics**	**No of MCQ**	**No of OSPE / OSCE Stations**	**Static / Interactive**
1.	Introduction to Cardiopulmonary Bypass, Equipment's and Circuit	5	2	Static and Interactive
2.	Principles and Operation of Three Key Components of Cardiopulmonary Bypass	5	1	Static
3.	Cardiopulmonary Bypass Monitoring	5	1	Static and Interactive
4.	Cardiopulmonary Bypass Setup and Safety Checks	5	1	Static
5.	Priming	5	1	Static
6.	Coagulation, Anticoagulation and Coagulation Testing	5	1	Static
7.	Coagulopathies and Hematological disorders	5	1	Static
8.	Blood Conservation Techniques	5	1	Static
9.	Basic formulas in CPB	5	1	Static
10.	Conduct of Cardiopulmonary Bypass	7	1	Static
11.	Myocardial Preservation	6	1	Static
12.	Metabolic Management during CPB	7	1	Static
13.	Weaning from Cardiopulmonary Bypass	5	1	Static
Total	**16**	**70**	**14**	**14**

THE END