Manipal College of Health Professions

Manipal Academy of Higher Education, Manipal

Outcome-Based Education (OBE) Framework

Four Years Full Time

Undergraduate Program

(Choice-Based Credit System)

Bachelor of Science in Cardiovascular Technology (BSc. CVT)

With effect from July 2024

C O N T E N T P A G E

Head of the Department **Dean**

Deputy Registrar - Academics **Registrar**

1. NATURE AND EXTENT OF THE PROGRAM

Cardiovascular Technology (CVT) is a Bachelor of Science (BSc) program that trains students extensively in cardiovascular diseases and diagnostic tests. Candidates undergo comprehensive training in various non-invasive imaging modalities to independently evaluate cardiac diseases and assist in operating equipment and performing cardiac catheterization procedures in invasive cardiac settings.

CVT encompasses both non-invasive and invasive fields of work, such as cardiac sonography and cardiac interventional technology. The scope for allied health workers in this field is expansive in today's medical sector and the foreseeable future.

The program is structured as a full-time course spanning eight semesters, including a one-year internship, following an outcome-based educational system. Our objectives include equipping candidates with knowledge in Basic Health Science subjects, clinical Cardiology, Electrocardiography, Cardiac Stress Testing, Ambulatory Blood Pressure and Holter Monitoring, Echocardiography, Cardiac Catheterization & Intervention, Biostatistics, and Research Methodologies.

Candidates applying for admission to the BSc CVT program should have passed the 10+2 examination or an equivalent two-year Pre-University/Pre-Degree examination conducted by the respective State's Pre-University Board of Education. Applicants must have studied Physics, Chemistry, and Biology (PCB) to be eligible for the program. Candidates should also be at least 17 years old at the time of admission to the first year of the BSc CVT program, or meet the entry age criteria set by their respective universities

2. PROGRAM EDUCATION OBJECTIVES (PEOs)

The overall objective of the learning outcome-based curriculum framework (LOCF) for BSc Cardiovascular Technology Program are as follows:

PEO No.	Education Objective
PEO 1	Students will be able to use their fundamental knowledge and clinical / technical competence in understanding the clinical concepts in cardiovascular sciences as and when required to achieve professional excellence.
PEO 2	Students will demonstrate strong and well defined clinical / practical skills while performing various diagnostic tests in cardiovascular diseases both noninvasive and invasive, along with diagnostic and therapeutic procedures
PEO 3	Students will be able to practice the profession with highly professional and ethical attitude, strong communication skills, and effective professional skills to work in a inter-disciplinary team.
PEO 4	Students will be able to use interpersonal and collaborative skills to identify, assess and formulate problems and execute the solution while independently handling live cases.
PEO 5	Students will be able to imbibe the culture of research, innovation, entrepreneurship and incubation throughout the learning period.
PEO 6	Students will be able to participate in lifelong learning process for a highly productive career and will be able to relate the concepts of cardiovascular science towards serving the cause of the society.

3. GRADUATE ATTRIBUTES

Sl No.	Attribute	Description
1	**Professional Knowledge**	Demonstrate scientific knowledge and understanding to work as a health care professional
2	**Clinical / technical / Laboratory / practical skills**	Demonstrate Clinical / technical / practical skills in order to implement the preventive, assessment and management plans for quality health care services
3.	**Communication**	Ability to communicate effectively and appropriately in writing and orally to patients/clients, care-givers, other health professionals and other members of the community
4.	**Cooperation/Team work**	Ability to work effectively and respectfully with interdisciplinary team members to achieve coordinated, high quality health care
5.	**Professional ethics**	Ability to identify ethical issues and apply the ethical values in the professional life
6.	**Research / Innovationrelated Skills**	A sense of inquiry and investigation for raising relevant and contemporary questions, synthesizing and articulating.
7.	**Critical thinking and problem solving**	Ability to think critically and apply once learning to real-life situations
8.	**Reflective thinking**	Ability to employ reflective thinking along with the ability to create the sense of awareness of one self and society
9.	**Information/digital literacy**	Ability to use ICT in a variety of learning situations
10.	**Multi-cultural competence**	Ability to effectively engage in a multicultural society and interact respectfully
11.	**Leadership readiness/qualities**	Ability to respond in an autonomous and confident manner to planned and uncertain situations, and should be able to manage themselves and others effectively
12.	**Lifelong Learning**	Every graduate to be converted into lifelong learner and consistently update himself or herself with current knowledge, skills and technologies. Acquiring Knowledge and creating the understanding in learners that learning will continue throughout life.

4. QUALIFICATION DESCRIPTORS:

a) Demonstrate (i) a fundamental and systematic knowledge and understanding of an academic field of study as a whole and its applications, and links to related disciplinary areas/subjects of study, including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues in the field of cardiovascular Technology; (ii) Procedural knowledge that creates different types of professionals related to the field of cardiovascular sciences both clinically and technically including research and development, teaching and in government and public service; (iii) Professional and communication skills in the domain of health care service including a critical understanding of the latest developments, and an ability to use established techniques in the domain of cardiovascular wellness program

b) Demonstrate comprehensive knowledge about learning integrated concepts in cardiac sciences including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to the cardiovascular field of study, and techniques and skills required for identifying problems and issues and to resolve them

c) Demonstrate skills in i) identifying the issues in cardiovascular health care needs; ii) collection of quantitative and/or qualitative data relevant to client's needs and professional practice; iii) analysis and interpretation of data using methodologies as appropriate for formulating evidence based hypotheses and solutions

d) Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to the cardiovascular technology

e) Communicate appropriately with all stakeholders, and provide relevant information to the members of the healthcare team

f) Address one's own learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge

g) Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts and to identify and analyse problems and issues and seek solutions to real-life problems

5. PROGRAM OUTCOMES (POs):

After successful completion of Bachelor / BSc in Cardiovascular Technology, students will be able to:

PO No.	Attribute	Competency
PO 1	**Professional knowledge**	Possess and acquire scientific knowledge to work as a health care professional
PO 2	**Clinical/ Technical skills**	Demonstrate and possess clinical skills to provide quality health care services
PO 3	**Team work**	Demonstrate team work skills to support shared goals with the interdisciplinary health care team to improve societal health
PO 4	**Ethical value & professionalism**	Possess and demonstrate ethical values and professionalism within the legal framework of the society
PO 5	**Communication**	Communicate effectively and appropriately with the interdisciplinary health care team and the society
PO 6	**Evidence based practice/learning**	Demonstrate high quality evidence based practice/learning that leads to excellence in professional practice
PO 7	**Life-long learning**	Enhance knowledge and skills with the use of advancing technology for the continual improvement of professional practice
PO 8	**Entrepreneurship, leadership and mentorship**	Display entrepreneurship, leadership and mentorship skills to practice independently as well as in collaboration with the interdisciplinary health care team

6. COURSE STRUCTURE, COURSE WISE LEARNING OBJECTIVE, COURSE OUTCOMES (COs)

SEMESTER - I

Course Code	Course title	Credit distribution (hours/week)				Marks Distribution			
		L	T	P	CL	CR	IAC	ESE	Total
ANA1301	Anatomy - I	3	-	-	-	3	30	70	100
PHY1301	Physiology - I	2	-	-	-	2	30	70	100
CSK1501	Communication Skills	2	-	-	-	2	100	-	100
EIC1501	Environmental Science & Indian Constitution	2	-	-	-	2	100	-	100
CVT1301	Cardiac Anatomy and Physiology	2	-	-	-	2	50	50	100
CVT1302	Basic ECG	2	1		-	3	50	50	100
CVT1303	Cardiac Embryology	2	1	-	-	3	50	50	100
CVT1304	Clinics - I	-	-	-	9	3	100	-	100
TOTAL		**15**	**2**	**-**	**3**	**20**	**510**	**290**	**800**
NOTE: ESE for ANA1301 & PHY1301 will be conducted for 50 marks and normalized to 70 marks. ESE for CVT1301 will be conducted for 50 marks, CVT1302 And CVT1303 will be conducted for 100 marks and normalized to 50 for grading									

SEMESTER - II

Course code	Course title	Credit distribution (hours/week)				Marks Distribution			
		L	T	P	CL	CR	IAC	ESE	Total
ANA1401	Anatomy - II	2	-	-	-	2	30	70	100
PHY1401	Physiology - II	2	-	-	-	2	30	70	100
BIC1401	Biochemistry	3	-	-	-	3	30	70	100
CVT1401	Advanced ECG and Holter Monitoring	3	1	-	-	4	50	50	100
CVT1402	Medical Ethics & Legal Aspects	2	-	-	-	2	100	-	100
CVT1403	ECG Interpretation, Holter Analysis - Practicals	-	-	8	-	4	50	50	100
CVT1404	Clinics - II	-	-	-	9	3	100	-	100
TOTAL		**12**	**1**	**4**	**3**	**20**	**390**	**310**	**700**
Note: ESE for ANA1401, PHY1401 & BIC1401 will be conducted for 50 marks and normalized to 70 ESE for CVT1401, CVT1403 will be conducted for 100 marks and normalized to 50 for grading Note: By the end of the first year, a student needs to complete a life skill training course offered by the university.									

SEMESTER - III

Course code	Course title	Credit distribution (hours/week)					Marks Distribution		
		L	T	P	CL	CR	IAC	ESE	Total
MCB2303	Microbiology	3	-	-	-	3	30	70	100
PAT2303	Pathology	3	-	-	-	3	30	70	100
CVT2301	Ultrasound Physics and Doppler Principles	2	1	-	-	3	50	50	100
CVT2302	Cardiac Stress Tests	2	1	-	-	3	50	50	100
CVT2303	Cardiac Instrumentations	2	-	-	-	2	100	-	100
CVT2304	Clinics - III	-	-	-	9	3	100	-	100
***** ******	Open Elective - I	-	-	-	-	3	S/NS		
TOTAL		**12**	**2**	**-**	**3**	**20**	**360**	**240**	**600**
Note: ESE for MCB2303 & PAT2303 will be conducted for 50 marks and normalized to 70 marks ESE for CVT2301, CVT2302 will be conducted for 100 marks and normalized to 50 for grading									

SEMESTER - IV

Course code	Course title	Credit distribution (hours/week)					Marks Distribution		
		L	T	P	CL	CR	IAC	ESE	Total
PHC2403	Pharmacology	3	-	-	-	3	30	70	100
CPY2401	Clinical Psychology	3	-	-	-	3	30	70	100
BST3401	Biostatistics and Research Methodology	3	-	-	-	3	30	70	100
CVT2401	Basics of Cardiac Implantable Electronic Devices	2	-	-	-	2	50	50	100
CVT2402	Congenital Heart Disease - I	3	1	-	-	4	50	50	100
CVT2403	Clinics IV	-	-	-	6	2	100	-	100
CVT2404	Program Elective - I (Cardiac Interventional Hardwares)	3	-	-	-	3	50	50	100
CVT2405	Program Elective - I (Analysis of Cardiac Implantable Electronic Devices)								
	TOTAL	**17**	**1**	**-**	**2**	**20**	**340**	**360**	**700**
Note: ESE for PHC2403 & CPY2401, will be conducted for 50 marks and normalized to 70 marks; BST3401 will be conducted for 100 marks and normalized to 70 marks grading, ESE for CVT2401 will be conducted for 50 marks, ESE for CVT2402 will be conducted for 100 marks and normalized to 50 for grading. ESE for CVT2404, CVT2405 will be conducted for 50 marks.									

SEMESTER - V

Course code	Course title	Credit distribution (hours/week)					Marks Distribution		
		L	T	P	CL	CR	IAC	ESE	Total
CVT3301	Basics in Cardiac Cath and Hardwares	3	1	-	-	4	50	50	100
CVT3302	Miscellaneous cardiovascular diseases	2	1	-	-	3	50	50	100
CVT3303	Congenital Heart Disease - II	2	1	-	-	3	50	50	100
CVT3304	Valvular Heart Disease	2	1	-	-	3	50	50	100
CVT3305	Clinics - V	-	-	-	12	4	100	-	100
***** ******	Open Elective - II	-	-	-	-	3	S/NS		
	TOTAL	**9**	**4**	**-**	**4**	**20**	**300**	**200**	**500**
Note: ESE for CVT3301, CVT3302, CVT3303 and CVT3304 will be conducted for 100 marks and normalized to 50 for grading									

SEMESTER - VI

Course code	Course title	Credit distribution (L,T,P, CL are hours/week)					Marks Distribution		
		L	T	P	CL	CR	IAC	ESE	Total
CVT3401	Applications of Echocardiography	3	1	-	-	4	50	50	100
CVT3402	Cardiac Cath and Interventions	3	1	-	-	4	50	50	100
CVT3403	General Cardiac Examination and BLS -ACLS	2	1	-	-	3	50	50	100
CVT3404	Practicals in Cardiac Cath and Imaging	-	-	6	-	3	50	50	100
CVT3405	Clinics - VI	-	-	-	9	3	100	-	100
CVT3406	Program elective - II (Cardiac Assist Devices)	3	-	-	-	3	50	50	100
CVT3407	Program elective - II (Imaging Modalities in Cardiac Diagnosis)								
TOTAL		**11**	**3**	**3**	**3**	**20**	**350**	**250**	**600**
Note: ESE for CVT3401, CVT3402, CVT3403, CVT3404 will be conducted for 100 marks and normalized to 50 for grading. ESE for CVT3406, CVT3407 will be conducted for 50 marks.									

Open Electives

Open elective is credited, choice-based and is graded as satisfactory / not satisfactory (S/NS). Students make a choice from pool of electives offered by MAHE institution / Online courses as approved by the department

Program Electives

Program elective is credited and choice-based. The students make a choice from pool of electives offered by the department. The ESE is conducted for 50 marks.

Program Elective

Semester	Course Code	Course Title	Credit (s) Distribution (L,T,P,CL are hours/ week)				
			L	T	P	CL	CR
IV Semester	**CVT2404**	Cardiac Interventional Hardwares	3	-	-	-	3
	CVT2405	Analysis of Cardiac Implantable Electronic Devices	3	-	-	-	3
VI Semester	**CVT3406**	Cardiac Assist Devices	3	-	-	-	3
	CVT3407	Imaging Modalities in Cardiac Diagnosis	3	-	-	-	3

SEMESTER - VII and VIII

Internship (1 year, 48 hours/week)

Semester VII	**Internship -** I	Duration 6 months 48 hours in a week / 8 hours in a day
Semester VIII	**Internship -** II	Duration 6 months 48 hours in a week / 8 hours in a day

OVERALL CREDIT DISTRIBUTION TABLE

SEMESTER	HOURS PER WEEK				TOTAL CREDITS	Marks		
	L	T	P	CL		IAC	ESE	Total
Semester - I	15	2	-	3	20	510	290	800
Semester - II	12	1	4	3	20	390	310	700
Semester - III	12	2	-	3	20	360	240	600
Semester - IV	17	1	-	2	20	340	360	700
Semester - V	9	4	-	4	20	300	200	500
Semester - VI	11	3	3	3	20	350	250	600
semester-VII / VIII	-	-		48	NA	-	-	-

SEMESTER -I

COURSE CODE	:	COURSE TITLE
ANA1301	:	Anatomy - I
PHY1301	:	Physiology - I
CSK1501	:	Communication Skills
EIC1501	:	Environmental Science & Indian Constitution
CVT1301	:	Cardiac Anatomy and Physiology
CVT1302	:	Basic ECG
CVT1303	:	Cardiac Embryology
CVT1304	:	Clinics - I

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Anatomy - I**
Course Code	**ANA1301**
Academic Year	First
Semester	I
Number of Credits	3
Course Prerequisite	Basic knowledge of biology
Course Synopsis	Human anatomy is the study of gross features and relations of various structures of the human body by dissection.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Explain the General Anatomy, respiratory, system of the human body (C1, C2)
CO2	Explain the cardiovascular, digestive system of the human body (C1, C2)
CO3	Explain the excretory, reproductive system of the human body (C1, C2)
CO4	Explain the endocrine, central nervous system, special senses of the human body (C1, C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes

Content	**Competencies**	**Number of Hours (Theory)**:
Unit 1		
General Anatomy	• Define the Anatomical position and Anatomical terms (C1) • Explain the epithelium - types and functions (C2) • Explain the connective tissue–fibers and cells (C2) • Explain the cartilage- types, structure and function(C2) • Explain the bone - types, structure and blood supply (C2)	7

Content	Competencies	Number of Hours (Theory):
	• Explain the muscle - classification, structure and function (C2) • Explain the neurons- types and structure, typical spinal nerve (C2) • Explain the blood vessels–arteries, veins, lymph vessels, lymph nodes, structure of lymph node (C2) • Explain the joints: Classification, examples , structure of a typical synovial joint (C2) • Ex plain the classification of synovial joints (C2)	
Unit 2		
Respiratory system	• List the parts of respiratory tract (C1) • Explain the boundaries of the Nasal cavity (C2) • Explain the Lateral wall of nasal cavity - features, blood supply, nerve supply and lymphatic drainage(C2) • Explain the nasal septum: Formation, blood supply, nerve supply, lymphatic drainage and applied anatomy (C1, C2) • List and Explain the paranasal air sinuses and their function (C1, C2) • Explain the pharynx - extent, parts- nasopharynx, oropharynx and laryngopharynx - internal features (C2) • Explain the cavity of larynx, blood supply, nerve supply (C1, C2) • Explain the vocal cords and their movements, and Rima glottidis (C2) • List the intrinsic muscles of the larynx, their nerve supply and actions (C1) • List the Cartilaginous framework and ligaments (C1) • Explain the trachea: Extent, Structure and nerve supply (C2) • Explain the diaphragm - attachments, nerve supply and actions (C2) • Explain the thoracic cage: thoracic wall, intercostal spaces and their contents (C1, C2) • Explain the Lungs- gross anatomy, roots of the lungs, surface marking of pleura and lungs (C1, C2) • Explain the pleura- parts, pleural cavity, pleural recesses, pulmonary ligament (C2)	5

Content	Competencies	Number of Hours (Theory):
Unit 3		
Cardiovascular system	• Explain the heart - position, external features, right atrium internal features (C1, C2) • Explain the right ventricle internal features, Blood supply to the heart (C1, C2) • Explain the left atrium and left ventricle, nerve supply of heart (C2) • Explain the pericardium - Parts, blood supply, nerve supply and function (C2) • Explain the mediastinum - boundaries and contents (C2) • List and explain the arteries - Arch of aorta and descending thoracic aorta (extent course and branches) (C1, C2) • Explain the veins -Azygos system of vein (formation, course and termination) (C1, C2) • Define the thoracic duct: formation, course and termination (C2) • Explain the arteries - pulmonary trunk, ascending aorta (extent course and branches) (C2) • Explain the veins - branchiocephalic veins, superior vena cava (formation, course and termination) (C2) • Explain the major arteries and veins of head and neck (name and positions) (C2) • Explain the major arteries and veins of abdomen and pelvis (name and positions) (C2) • Explain the abdominal aorta, inferior vena cava, portal vein (C1, C2)	4
Unit 4		
Digestive system	• List the parts of digestive system (C1) • Explain the tongue–gross anatomy, blood supply and nerve supply (C2) • Explain the salivary glands- Names and location (C2) • Explain the oesophagus- extent, parts, constrictions, blood supply, nerve supply and lymphatic drainage (C2) • Explain the stomach- position, relations, blood supply, nerve supply and lymphatic drainage (C1, C2) • Explain the duodenum- parts, important relations, blood supply and nerve supply (C2) • Explain the pancreas–position, parts, important	6

Content	Competencies	Number of Hours (Theory):
	relations, blood supply and nerve supply (C2) • Explain the small intestine–parts- duodenum, jejunum and ileum- blood supply and nerve supply (C1, C2) • Explain the large intestine–parts, position of each of the parts, extent, blood supply and nerve supply (C2) • List the differences between jejunum and ileum (C1) • List the differences between small intestine and large intestine (C1) • Explain the rectum and anal canal-position, blood supply, nerve supply and lymphatic drainage (C2) • Explain the liver- position, anatomical and physiological lobes, surfaces, relations, porta hepatis, blood supply and nerve supply (C1, C2) • Explain the extrahepatic biliary apparatus–gall bladder and bile duct (C2)	
Unit 5		
Urinary system	• List the parts of urinary system (C1) • Explain the kidneys: position, external features, capsules, relations, macroscopic structure, blood supply and nerve supply (C1, C2) • Explain the ureter- length, constrictions and blood supply (C2) • Explain the urinary bladder- position, external features, blood supply and nerve supply (C2) • Explain the urethra- female urethra, male urethra- parts (C2)	2
Unit 6		
Male reproductive system	• List the parts of male reproductive system (C1) • List the spermatic cord- constituents and coverings (C1) • Explain the testes- position, coverings, gross structure, blood supply, nerve supply and lymphatic drainage (C2) • Explain the vas deferens- commencement, course and termination (C2) • Explain the prostate–position, external features, lobes and structure (C2) • Explain the seminal vesicles and ejaculatory ducts (C2)	2

Content	Competencies	Number of Hours (Theory):
Unit 7		
Female reproductive system	• Name the parts of female reproductive system (C1) • Explain the uterus-position, parts, external features, relations, blood supply and lymphatic drainage (C2) • Explain the uterine tube- parts, blood supply and nerve supply (C2) • Explain the ovary – position and structure (C2)	2
Unit 8		
Endocrine glands	• Name the endocrine glands (C1) • Explain the pituitary gland (Hypophysis cerebri)- position, parts, blood supply (C2) • Explain the suprarenal glands- position, relations, parts, blood supply and lymphatic drainage (C2) • Explain the thyroid gland- position, parts, blood supply and lymphatic drainage (C2) • Name the parathyroid glands-their position and blood supply (C1)	2
Unit 9		
Central Nervous system	• Name the parts of the CNS (C1) • List the features and explain the spinal cord- position, external features, internal structure, brief note on important ascending and descending tracts (C1, C2) • Explain the major motor and sensory pathways (C2) • Explain the pyramidal tract in detail (C2) • Name the parts of brain (C2) • List the external and internal features of medulla oblongata (C1) • List the cranial nerves attached to medulla oblongata(C1) • List the external and internal features pons (C1) • Explain the cranial nerves attached to pons and ponto-medullary junction (C2) • Explain the cerebellum- functional lobes of the cerebellum and its functions (C2) • Explain the midbrain- external features and internal structure–in brief (C1) • Explain the cranial nerves attached to midbrain (C2) • Explain the cerebral hemispheres–lobes, important sulci and functional areas (C2)	12

Content	Competencies	Number of Hours (Theory):
	• List the fiber system of the brain and explain the corpus callosum and internal capsule (C1, C2) • Explain the diencephalon- Thalamus and hypothalamus-position and functions (C2) • Explain the basal nuclei: Corpus striatum–parts and functions (C2) • Explain the blood supply to the central nervous system (C2) • Explain the ventricles: 4th and 3rd ventricles (features, position and communications) (C2) • Explain the lateral ventricles- parts, features, position and communications (C2) • Define the CSF production and circulation (C1)	
Unit 10		
Special senses	• Recall the gross anatomy of the eye (C1) • Recall the gross anatomy of external, middle and internal ear (C1) • Recall the skin and its features (C1)	3
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	45	-
Revision	-	-
Assessment	-	-
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Nil	Sessional Exam I / Sessional Exam II (Theory)
	End Semester Exam (Theory)

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Sessional Examination 1	x	x	-	-
Sessional Examination 2	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Manipal Manual of Anatomy by Dr. Sampath Madhyastha
Additional References	1. Human Anatomy by Dr. B. D. Chaurasia (Vol 1,2,3,4) 2.Chaurasia's handbook of human anatomy 3.Netter's Atlas

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Physiology - I**
Course Code	**PHY1301**
Academic Year	First
Semester	I
Number of Credits	2
Course Prerequisite	Basic knowledge of biology
Course Synopsis	This module provides a comprehensive knowledge about normal functions of the organ systems of the body to understand the physiological basis of health and disease required for health professional (paramedical) courses.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Explain the various transport mechanisms across the cell membrane, composition and distribution of body fluids, components of blood and their functions, blood groups, blood coagulation and the basis for related diseases. (C1, C2)
CO2	Describe the morphology and functions of nerve and muscles. (C1, C2)
CO3	Explain the functions of cardiovascular and respiratory systems to facilitate the understanding of health & disease process (C1, C2)
CO4	Describe the physiology of special sense organs and the related disease process (C1, C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1. BASIC CONCEPTS AND NERVE PHYSIOLOGY		
Transport across cell membrane	• Name the various transport mechanisms across cell membrane(C1) • Describe passive transport mechanisms such as simple diffusion, facilitated diffusion and osmosis (C2) • Describe primary and secondary active transport mechanisms(C2)	4

Content	Competencies	Number of Hours
Body fluid compartments	• Mention the total body water as percentage of body weight and its distribution. (C1) • Give the ionic com position of body fluids(C1)	
Physiology of neuron	• Describe the morphology of a neuron (C2) • Mention the structure and functions of myelinated and unmyelinated nerve fibers (C2)	
Membrane potential	• Describe restin g membrane potential(C2) • Draw and label the action potential (C2) • Describe the ionic basis of the action potential (C2)	
Unit 2: MUSCLE PHYSIOLOGY		
Skeletal muscle	• Describe the characteristic features of skeletal, cardiac and smooth muscles(C2) • Describe the structure of skeletal muscles(C2) • Mention the types of skeletal muscles(C1) • Explain neuromuscular transmission in skeletal muscle(C2) • Explain excitation contraction coupling in skeletal muscle(C2) • Describe rigor mortis (C2)	4
Smooth muscle	• Mention the types of smooth muscle(C1)	
Unit 3: BLOOD		
Composition and functions of blood	• Describe the composition of blood(C2) • List the functions of blood (C1)	6
Plasma proteins	• Name the different types of plasma proteins (C1) • List the functions of plasma proteins(C1)	
Red blood cells	• Mention the morphology and functions of red blood cells (C1) • Mention the normal count of RBC and its variations (C1) • Describe the sites, stages and factors influencing erythropoiesis(C2) • Mention the normal value of hemoglobin concentration and its variations (C1) • Mention the functions of hemoglobin (C1) • Define anemia and describe the morphological classification of anemia (C1, C2)	
White blood cells	• Classify White Blood Cells (WBC) (C2) • List the functions of WBCs(C1) • Mention the normal count of various types of WBCs (C1)	

Content	Competencies	Number of Hours
Hemostasis	• Mention the normal range of platelets and its variations(C1) • List the functions of platelets(C1) • Define hemostasis(C1) • Describe the various stages involved in haemostasis (C2) • List the clotting factors(C1) • Describe the intrinsic and extrinsic pathways of coagulation (C2) • Describe hemophilia(C2) • Classify anticoagulants and give examples for each(C2)	
Blood types/groups	• State Landsteiner's law (C1) • Describe the ABO and Rh systems of blood grouping(C2) • Explain the importance of blood grouping(C2) • Mention the hazards of blood transfusion(C1) • Explain the cause and clinical features of hemolytic disease of the newborn (erythroblastosis fetalis) (C2)	
Lymph	• List the functions of lymph (C1)	
Unit 4: CARDIOVASCULAR SYSTEM		
Organization of cardiovascular system	• Describe the structure of heart (C2) • Describe the innervation of heart and blood vessels(C2) • Describe the properties of cardiac muscle (C2)	9
Cardiac cycle	• Define cardiac cycle (C1) • State the normal duration of cardiac cycle (C1) • Describe the left ventricular pressure and volume changes during a cardiac cycle(C2)	
Heart sounds	• Enumerate the differences between first and second heart sounds(C2)	
Electrocardiogram (ECG)	• Define electrocardiogram (ECG) (C1) • Draw a labeled diagram of a normal ECG recorded from limb lead II (C1) • Describe the waves and intervals of ECG (C2) • Mention the uses of ECG (C1)	
Heart rate	• Mention the normal value and variations of heart rate(C1)	
Cardiac output	• Define cardiac output (C1) • State the normal value of cardiac output (C1) • Mention the variations of cardiac output(C1) • Describe the regulation of cardiac output(C2)	

Content	Competencies	Number of Hours
Blood pressure (BP)	• Define blood pressure (BP) (C1) • Mention the normal value of BP (C1) • Mention the factors influencing BP(C1) • Mention the variations of blood pressure(C1) • Describe the short term regulation of arterial blood pressure(C2)	
Unit 5: RESPIRATORY SYSTEM		
Introduction to respiration	• Describe the functional anatomy of the respiratory system (C2)	6
Mechanics of Respiration	• Mention the muscles of respiration(C1) • Describe the mechanism of inspiration and expiration(C2) • Describe the intra-pulmonary and intra-pleural pressure changes during the various phases of respiration(C2)	
Lung volumes and capacities	• Draw a labelled spirogram(C2) • Define various lung volumes and capacities (C1) • Mention the normal values of lung volumes and capacities (C1)	
Ventilation	• Define pulmonary ventilation (C1) • Mention the normal value of pulmonary ventilation (C1) • Define alveolar ventilation(C1) • Mention the normal value of alveolar ventilation(C1) • Define anatomical dead space (C1) • Mention the normal value of anatomical dead space (C1)	
Gas exchange	• Describe the structure of respiratory membrane (C2) • Mention the factors affecting diffusion of gases across it (C1)	
Transport of gases	• Mention the forms in which oxygen is transported in the blood(C1) • Describe the oxygen-hemoglobin dissociation curve(C2) • Mention the factors shifting the oxygen-hemoglobin dissociation curve to the right and to the left(C1) • Mention the forms in which carbon dioxide is transported in the blood(C1) • Describe the mechanism of carbon dioxide transport(C2)	

Content	Competencies	Number of Hours
Regulation of respiration	• Explain the neural regulation of respiration(C2) • Explain the chemical regulation of respiration(C2)	
Applied aspects	• Define hypoxia(C1) • Mention the types of hypoxia with example (C1) • Define cyanosis(C1) • Mention the cause of cyanosis (C1) • Define apnea, dyspnea and asphyxia(C1)	
Unit 6: SPECIAL SENSES		
Vision	• Describe the structure of human eye with the help of a diagram (C2) • Mention the functions of aqueous humor (C1) • Name the photoreceptors (C1) • Mention the differences between the rods and cones (C1) • Draw the visual pathway (C2) • Explain the defects in field of vision due to lesions of visual pathway at different locations (C2) • Describe the mechanism of accommodation(C2) • Describe light reflex with the help of a diagram(C2) • Define visual acuity and mention the tests (C2) • Describe the cause and correction for refractory errors of the eye(C2)	4
Hearing and vestibular apparatus	• Describe the structure and functions of external, middle and inner ear (C2) • Describe the mechanism of hearing (C2) • Mention the parts and functions of vestibular apparatus (C1)	
Taste and smell	• Name the receptors for taste and smell (C1) • Mention the disorders of taste and smell (C1)	
	Total	**33**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	33	-
Revision	4	-
Total	**37**	**37**
Assessment Methods:		
Formative:	**Summative:**	
Nil	Sessional Exam I / Sessional Exam II (Theory)	
	End Semester Exam (Theory)	

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Sessional Examination 1	x	x	-	-
Sessional Examination 2	-	-	x	x
End Semester Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Basics of Medical Physiology,4th edition, D.Venkatesh, H.H.Sudhakar			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Communication Skills**
Course Code	**CSK1501**
Academic Year	First
Semester	I
Number of Credits	2
Course Prerequisite	Nil
Course Synopsis	Orients students to focus on diverse interactive situations and enhances the interpersonal skills required as per the needs of the current professional environment

Course Outcomes (COs): At the end of the course student shall be able to	
CO1	Identify the components of communication skills and apply them in a professional setting with an emphasis on professional communication specifically on presentation and corporate etiquette (C3)
CO2	Outline effective oral communication skills in diverse contexts (C2)
CO3	Summarise different ways to write creatively, coherently and effectively on a given topic (C2)
CO4	Develop active listening skills involving feedback in diverse interactive situations. (C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1					x		x	
CO2					x		x	
CO3		x					x	
CO4			x				x	

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours (Theory)**
Unit 1		
Communication Skills	1. Define Communication (C1) 2. Outline the process and barriers in Communication (C2) 3. Explain the types of communication (C2) (Oral, Verbal, non-verbal, dyadic) 4. How to improve spoken skills (C1)(Telephone, face-to-face) 5. How to improve communication (C1) 6. Apply the concepts of communication skills in a professional setting with an emphasis on	8

Content	Competencies	Number of Hours (Theory)
	presentation and corporate etiquette (C3) 7. Identify the difference between formal and informal communication (C3)	
Unit 2		
Reading Skills	1. Explain the types of reading (C2) 1. (Oral, Silent, Extensive, Scanning, Skimming) 2. Outline the reading techniques (C2) (3Q3R) 3. What is the difference between scanning and skimming(C1) 4. Define source of information (C1) 5. Explain feedback on LSWR in individual presentations (C2) 6. Summarise the role played by prepositions in understanding what to read (C2)	6
Unit 3		
Listening Skills	1. Explain the types of listening (C2) 2. Summarize the context and purpose of listening (C2) 3. Explain various types of listening obstacles (C2) 4. How to improve hearing and focused listening (C1) 5. 5. What is facilitating understanding, static & process description-gambits (C1)	8
Unit 4		
Writing skills	1. What is the difference between spoken and written form (C1) 2. How words are formed into phrases & clauses (C1) 3. Outline writing paragraphs, cohesion, and coherence (C2) 4. Explain summary, precise and essay writing (C2) 5. How to write a formal and informal letters (C1) 6. How to write a resume /CV(C1) 7. Explain the role of visual aids and meetings in writing (C2) 8. Explain the importance of abbreviations and punctuations in writing(C2)	8
	Total	**30**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	24	-
Seminar	6	-
Total	**30**	**30**

Learning Assessment Methods:				
Formative:	Summative:			
Class Presentation/Assignment	Sessional Exam II (Theory)			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Assignments	x	x	x	-
Mid Semester Examination	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Jain, A K & et al., (2008-5th Edition). Professional Communication Skills, 2008, New Delhi, S Chand and Company 2. Raman, M., & Singh, P. (2012). Business communication. New Delhi: Oxford University Press 3. The Professional Communications Toolkit by D. Joel Whalen Sage publication 2006.			
Additional References	1. Raman, M & Sharma, S (2014). Technical communication: Principles and Practice. New Delhi: Oxford University			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Environmental Science**
Course Code	**EIC1501**
Academic Year	First
Semester	1
Number of Credits	1
Course Prerequisite	Nil
Course Synopsis	1. Aim to give students a general understanding of environmental science and introduce them to some of the main principles 2. It covers the study of subjects for example, understanding of earth procedures, evaluating alternative energy frameworks, mitigation and pollution control, natural resource management, effects of global climate change, and so on

Course Outcomes (COs): **At the end of the course students shall be able to:**	
CO1	Explain the role of Environmental Science, its multidisciplinary nature in conservation of global environment (C2)
CO2	Describe the natural resources, utility and the role of ecosystems in maintaining planetary cycles (C2)
CO3	Outline the types, sources, prevention and control measures of pollution (C2)
CO4	List the laws, acts and policies related to environmental protection in India (C1)
CO5	Explain the types, mitigation and management techniques of disaster (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x					x		
CO2	x			x				
CO3	x					x		
CO4			x				x	
CO5			x			x		

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
Environmental Studies and multi-disciplinary nature	1. Explain the meaning, objectives and major environmental issues (C2) 2. What is sustainable development? (C1) 3. Explain the global environmental concerns (C2)	2

Content	Competencies	Number of Hours
Unit 2		
Biodiversity, Ecosystem, Energy and natural resources	1. Classify the natural resources (C2) 2. List the renewable and non- renewable resources (C1) 3. Outline the consumption of renewable and non-renewable resources 4. Explain the conservation methods of renewable and non-renewable resources 5. Outline the availability of water resources, forest, land and mineral resources. 6. Summarize the different types of energy (C2) (Conventional sources & Non-Conventional sources of energy, solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas, Fossil Fuels, Hydrogen as an alternative energy) 7. Define Ecosystem (C1) 8. Explain the meaning, structure and functions of ecosystem (C2) 9. Explain the biotic and abiotic components of ecosystem (C2) 10. Describe the trophic levels in ecosystem (C2) 11. What is an energy flow in an ecosystem (C1) 12. Explain Biodiversity and its conservation (C2) (in situ & ex situ, IUCN red list)	4
Unit 3		
Environmental Pollution	1. Explain the various types of Environmental Pollution (C2) (water, air, land, noise, solid waste, Biomedical waste, nuclear pollution, marine pollution)	2
Unit 4		
Environmental laws and legislations	1. Outline the environmental laws and legislations (C2) (Related to general, air, water, biodiversity and forests) 2. Explain the roles and responsibilities of state and central Pollution control Boards (C2) 3. What is Environmental impact assessment (EIA) (C1)	2
Unit 5		
Disaster management	1. Define disaster (C1) 2. What is disaster management? (C1) 3. Classify the types of disaster (C2) 4. What is disaster risk formula (C1)	3

Content	Competencies	Number of Hours
	5. Explain the phases in Disaster management phases (C2) **(Disaster management cycle, Emergency response and recovery, Hazardous waste spills and dangers posed)**	
	Total	**13**

Learning Strategies, Contact Hours and out of class engagement:		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	13	-
Seminar	-	-
Assessment	2	-
Total	**15**	**15**

Assessment Methods:	
Formative:	**Summative:**
Assignments	Mid Semester/Sessional Exam (Theory)

Mapping of Assessment with COs:					
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Class test	-	-	x	x	x
Mid Semester / Sessional Examination	x	x	x	-	-

Feedback Process:	End-Semester Feedback
Main Reference:	1. Benny Joseph, Environmental Studies, Tata McGraw-Hill Publishing Company Ltd., New Delhi (2008). 2. Aloka Debi, “Environmental Science and Engineering”, Universities Press (India) Pvt. Ltd. (2012).
Additional References	1. Mohan kanda, Disaster Management in India evolution of institutional arrangements & operational strategies. (2017) 2. Student guide: Environment Reader for Universities, based on UGC syllabus published by Centre for Science and Environment, (2017). 3. G.Swarajya Lakshmi, Environmental science: A Practical Manual, (2010).

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	Indian Constitution
Course Code	**EIC1501**
Academic Year	First
Semester	I
Number of Credits	1
Course Prerequisite	Nil
Course Synopsis	1. To provide understanding of knowledge of the Indian constitution. 2. To familiarize students with the fundamental rights and duties. 3. To understand the importance of constitutional laws. 4. To understand the correlation between Indian constitution, democracy and society.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Explain the salient features, importance and need of the Constitution (C2)
CO2	Infer the need of fundamental rights in a democratic system for a holistic development of a society (C2)
CO3	Outline the directions given to the state by the constitution and fundamental duties of a citizen towards the state. (C2)
CO4	Explain the working nature of State and Centre, roles and responsibilities of President and Governors, amendments emergency powers enjoyed by the government (C2)
CO5	List various laws listed under IPC and CrPC and understand importance of voting in a democracy and RTI (C1)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2				x	x			
CO3			x				x	
CO4						x		x
CO5				x			x	

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Introduction to Indian Constitution	1. Outline the evolution of the Legal System (C1) (pre-colonial and colonial times, Common Law, Civil Law and Socialist Legal System) 2. Explain the constitutional history and constitutional assembly (C2) 3. Explain the various organs of the Government (C2) (Executive, Legislature and Judiciary, and Panchayat institutions) 4. Summarise the functions of high court and supreme court of India (C2)	3
Unit 2		
Fundamental Rights	1. Explain the individual rights and fundamental rights (C2) 2. Outline the history of the demand for fundamental rights (C2) 3. Classify the fundamental rights (C2) 4. Explain how fundamental rights are a guarantee against state action (C2) 5. Summarise Article 14 to Article 30 (C2) 6. Explain supreme court as the guardian of Fundamental Rights (C2)	4
Unit 3		
Fundamental Duties and Directive Principles of State Policy	1. Explain fundamental duties and its enforcement (C2) 2. Summarise the utility and the scope of DPSP(C2) 3. Outline the socialistic pattern of society (C2) 4. Explain the conflict between fundamental rights and DPSP (C2)	3
Unit 4		
Role of President and Governors/ Cabinet	1. What is the procedure followed while electing a President (C1) 2. Explain the power and duties of the President (C2) 3. Outline the power and duties of the Governors (C2) 4. Explain the role and functions of the council of Ministers (C2)	2
Unit 5		
Role of citizens, Constitutional laws(IPC and CrPC), RTI	1. Explain the role of citizens in a democracy (C2) 2. Explain constitutional laws (C2) 3. Explain the Indian Penal Code and Code of Criminal Procedure (C2) 4. Summarise right to Information (C2)	3
	Total	**15**

Learning Strategies, Contact Hours and out of class engagement :						
Learning Strategies	**Contact Hours**		**Out of class engagement**			
Lecture	15		-			
Total	**15**		**15**			
Assessment Methods:						
Formative:	**Summative:**					
Assignments	Mid Semester/Sessional Exam (Theory)					
Mapping of Assessment with COs:						
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	
Class test	-	x	-	x	x	
Mid Semester / Sessional Examination	x	x	x	-	-	
Feedback Process:	End-Semester Feedback					
Main Reference:	1. Subhash C**.** Kashyap, Our Constitution, National Book Trust. (2011) 2. P. M. Bhakshi. The Constitution of India. Universal Law Publishing.(2017)					
Additional References	1. Dr. B. R. Ambedkar. The Constitution of India. Educreation Publishing. (2020) 2. Bipan Chandra.History of Modern India. Orient BlackSwan. (2009) 3. Dr. Durga Das Basu. Introduction to the Constitution of India. Lexis Nexis.(2013)					

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Anatomy and Physiology**
Course Code	**CVT1301**
Academic Year	First
Semester	I
Number of Credits	2
Course Prerequisite	Foundational knowledge in human anatomy and physiology, particularly focusing on the basics of the cardiovascular system.
Course Synopsis	This course covers the cardiac circulatory system, including hemodynamic changes, valve structure, and blood pressure measurement. It connects basic anatomy to clinical applications, enabling students to identify cardiac structures, understand medical terms, diagnose cardiovascular diseases, and analyze hemodynamic data.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	To build knowledge on basic medical terminologies, systemic pulmonary circulation, and phases of the cardiac cycle (C3)
CO2	To build knowledge on the basic anatomy of the heart involving layers of the heart, chamber anatomy, valve anatomy, and circulatory system of the body(C3)
CO3	To build knowledge on measuring blood pressure, arterial pulse, heart sounds, and murmurs.(C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x						x	
CO3	x						x	

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
Medical terminologies and circulation	• Medical terminology (C1) • Understand Systemic and pulmonary circulation (C2)	2
Unit 2		
Cardiac cycle	• Explain the Phases of systole (C2) • Explain the phases of diastole (C2)	3

Content	Competencies	Number of Hours
	• Understanding event timings - Stroke volume/cardiac output (C2)	
Unit 3		
Conduction system of the heart	• Explain the conduction system of SA node (C2) • Explain the conduction system of AV node (C2) • Explain the conduction system of Bundle of His (C2) • Explain the conduction system of Bundle branches (C2) • Explain the conduction system of Purkinje fibres (C2)	3
Unit 4		
Layers of the heart	• Outline the anatomy of the endocardium. (C2) • Outline the anatomy of Myocardium. (C2) • Outline the anatomy of the pericardium. (C2)	2
Unit 5		
Chamber identification and anatomic variance	• Identify the cardiac anatomical variances of Right atrium (C3) • Identify the cardiac anatomical variances of Right ventricle (C3) • Identify the cardiac anatomical variances of Left atrium (C3) • Identify the cardiac anatomical variances of Left ventricle (C3)	3
Unit 6		
Anatomy of valves	• Outline the anatomy of Mitral valve (C2) • Outline the anatomy of Tricuspid valve (C2) • Outline the anatomy of Aortic valve (C2) • Outline the anatomy of Pulmonary valve (C2)	2
Unit 7		
Circulatory system of the body	• Explain the anatomy of coronary artery circulation. (C5) • Explain the anatomy of the venous drainage system of the heart. (C5) • Explain the anatomy of the aorta and its peripheral branches. (C5) • Explain the anatomy of the vena cava and its branches. (C5)	3
Unit 8		
Blood Pressure	• Definition and components of the arterial BP(C1) • Determinants of arterial BP(C5) • Explain the Measurement of arterial BP	3

Content	Competencies	Number of Hours
	- Direct and indirect method (C5) • Build skills in BP systolic and diastolic measurement. (C3)	
Unit 9		
Arterial pulse	• Explain the definition and genesis of the arterial pulse. (C5) • Explain the pulse wave pattern in ascending aorta and peripheral arterial pulse. (C5) • To build knowledge on examination of the arterial pulse: Rate, rhythm, character, and volume of the pulse (C3) • Explain the characteristic feature of the pulse in common clinical conditions (C5)	4
Unit 10		
Heart sounds and murmurs	• Explain the first heart sound, second heart sound, diastolic and systolic heart sound. (C5) • Explain the abnormal heart sound. (C5) • Explain the definition and mechanism of production of the heart murmur. (C5) • Explain the characteristics of murmur: systolic, diastolic, and continuous murmur. (C5)	5
	Total	**30**

Learning Strategies, Contact Hours, and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	26	-
Revision	2	-
Assessment	2	-
Total	**30**	**30**

Assessment Methods:	
Formative:	**Summative:**
Assignments	Mid Semester Exam
	End Semester Exam

Mapping of Assessment with COs:			
Nature of Assessment	**CO1**	**CO2**	**CO3**
Mid Semester Exam	x	x	-
Assignments	-	-	x
End Semester Exam	x	x	x

Feedback Process:	**End-Semester Feedback**
Main Reference:	1.Manipal Manual of Anatomy 2.Gray's Text book of Anatomy 3. Clinical examination in cardiology textbook by Vijay Raghawa Rao
Additional References	1.The Heart – by Hurst's

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Basic ECG**
Course Code	**CVT1302**
Academic Year	First
Semester	I
Number of Credits	3
Course Prerequisite	Knowledge of cardiac anatomy, conduction system, and electrophysiology of the heart.
Course Synopsis	This module will offer comprehensive insights into the cardiac conduction system, essential electrocardiography concepts, techniques for identifying heart rate, axis and sinus rhythm, and strategies for interpreting ECGs in abnormal conditions like dextrocardia, chamber enlargement, conduction abnormalities, myocardial infarction, and miscellaneous conditions.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Understand the electrophysiology of the heart. (C2)
CO2	Define the role of unipolar and bipolar leads, Einthoven triangle, degree, and axis of the heart. (C1)
CO3	Interpret ECG normal waveforms, rhythm, and heart rate. (C5)
CO4	Understand the techniques for interpreting and concluding the diagnosis of ECG in dextrocardia, chamber enlargement, hypertrophy, intraventricular conduction abnormalities, AV block, myocardial infarction, and pericarditis. (C5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x						x	

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1		
Electrophysiology of the heart	• Recall the electrical impulse transmission through the conduction system of the heart(C2) • Explain Intracellular potential (C2) • To understand and explain electrical potential produced by normal cardiac muscle (C2	3

Content	Competencies	Number of Hours
	• Describe Relative and absolute refractory period (C2) • Apply the skills of electrophysiology in distribution of electrical axis of heart (C2)	
Unit 2		
Lead system in ECG	• Define the role of lead system in Unipolar leads (C1) • Define the role of lead system in Bipolar (C1) • Illustrate the placement of unipolar, bipolar, and precordial leads (C1)	4
Unit 3		
Interpretation of ECG	• To describe the importance of Standardization in an ECG (C4) • To interpret the normal and abnormal P wave (C4) • To describe the genesis of QRS waveforms; To interpret different QRS morphology (C4) • To interpret the normal PR interval, PR segment and ST segment (C4) • To interpret the normal and abnormal QTc interval (C4) • Methods to determine Heart rate in regular and irregular rhythm (C4) • Describe various methods of assessing electrical axis and degree (C3)	8
Unit 4		
ECG Rhythm	• To assess the Sinus rhythm (C4) • To assess the Regular, Irregular rhythms (C4)	1
Unit 5		
ECG in Dextrocardia	• To discover True Dextrocardia (C4) • To discover Technical Dextrocardia (C4)	2
Unit 6		
ECG in atrial enlargement and Hypertrophy	• To assess the ECG with respect to Right atrial enlargement (C5) • To assess the ECG with respect to Left atrial enlargement (C5) • To assess the ECG with respect to Bi - atrial enlargement (C5)	3
Unit 7		
ECG in ventricular enlargement and Hypertrophy	• To assess the ECG with respect to Left ventricular hypertrophy –Volume/pressure overload (C5) • To assess the ECG with respect to Right	6

Content	Competencies	Number of Hours
	ventricular hypertrophy – Volume/pressure overload (C5) • To assess the ECG with respect to Bi-ventricular hypertrophy (C5)	
Unit 8		
ECG in intra-ventricular conduction abnormalities	• To analyze the intra-ventricular conduction abnormalities and Bundle branch block –Typical and Atypical LBBB, RBBB(C4) • To analyze the intra-ventricular conduction abnormalities and Fascicular block (C4) • To analyse Bi Fascicular block & Tri fascicular block (C4) • To analyze the intra-ventricular conduction abnormalities in Bundle branch block associated with ventricular hypertrophy (C4)	6
Unit 9		
ECG in SA block and AV block	• To analyze the conduction abnormality in the SA node (C2) • Describe ECG changes in SA block / Sick sinus syndrome (C4) • To analyze the blocks in the AV node; First-degree AVB, second-degree AVB, third-degree AVB (C4)	4
Unit 10		
Identification of variants of ECG in Myocardial infarction (MI)	• To interpret and conclude the diagnosis of ECG in Ischemia, injury, infarction (C5) • To interpret and conclude the diagnosis of ECG in ST-T changes –changes in QRS complex (C5) • To interpret and conclude the diagnosis of ECG in Localization of MI (C5) • To interpret and conclude the diagnosis of ECG in Identification of culprit vessel (C5) • To interpret and conclude the diagnosis of ECG in Right ventricular MI and atrial MI (C5) • To interpret and conclude the diagnosis of ECG in MI associated with bundle branch blocks – Sgarbossa criteria (C5)	6
Unit 11		
ECG in Miscellaneous conditions	• To analyse the ECG findings in Pericarditis (C4) • To understand the ECG differentiation of Pericarditis with MI (C4)	2
	Total	45

Learning Strategies, Contact Hours, and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	37	-
Assignment	5	-
Revision	1	-
Assessment	2	-
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Assignment/presentation	Mid Semester Exam (Theory)
	End Semester Exam (Theory)

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid-Semester / Sessional Examination 1	x	x	x	-
Assignments/Presentations	-	x	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. An Introduction to Electrocardiography 8Ed by Leo Schamroth 2. Principles of Clinical Electrocardiography by Mervin J. Goldman 3. Marriott's Practical Electrocardiography by Galen S. Wagner, David G. Strauss

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Embryology**
Course Code	**CVT1303**
Academic Year	First
Semester	I
Number of Credits	3
Course Prerequisite	Basic understanding of developmental biology or embryology, along with fundamental knowledge of human anatomy
Course Synopsis	This course offers a comprehensive overview of early embryonic development and the intricate processes involved in heart formation. The students will learn about heart tube formation, cardiac looping, atrial and ventricular development, formation of cardiac valves, the fate of structures such as truncus arteriosus, pharyngeal arch arteries, great cardiac veins, pericardium development, and coronary artery formation. This foundational understanding enables the students to comprehend congenital heart diseases effectively.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Define and understand the early development of the embryo, heart tube formation, and cardiac looping (C2)
CO2	Understand the formation of atria, inter atrial septum, and cardiac valves (C2)
CO3	Define and understand the formation of ventricles and inter ventricular septum (C2)
CO4	Explain and understand the formation of truncus arteriosus, pharyngeal arch arteries, great cardiac veins, pericardium, and coronary arteries. (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Early development of embryo	• Define and Explaining the stages of cell division Mitosis and Meiosis(C2) • Define and Explaining the stages of spermatogenesis and oogenesis(c2) • Explain the stages of fertilization(C2) • Explain the formation of Germ layers(C2) • Explain the development of placenta(C2)	14
Unit 2		
Development of the heart	• Explain the formation of heart tube(C2) • Explain the formation of cardiac looping(C2) • Explain the development of sinus venosus (C2)	4
Unit 3		
Formation of Atria	• Explain the formation of atria(C2) • Explain the formation of right and left atrium(C2) • Explain the stages in the formation of Inter atrial septum(C2)	5
Unit 4		
Formation of Cardiac Valves	• Explain the formation of AV valves and Semilunar valves(C2)	1
Unit 5		
Formation of Ventricles	• Explain the development of Ventricles(C2) • Explain the stages in formation of Inter ventricular septum(C2)	5
Unit 6		
Fate of truncus arteriosus	• Explain the development of Pharyngeal arch arteries and their fate(C2) • Explain the Anomalous development of pharyngeal arch arteries (C2)	6
Unit 7		
Formation of great cardiac veins	• Explain the development of great cardiac veins(C2) • Explain the fate of cardinal veins (C2) • Explain the fate of vitelline veins, umbilical veins(C2) • Explain the fate of Ductus venosus, Superior vena cava, Inferior vena cava(C2)	8
Unit 8		
Formation of Pericardium	• Explain the formation of Pericardium(C2)	2
	Total	**45**

Learning Strategies, Contact Hours, and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	40	-
Seminar	2	-
Revision	2	-
Assessment	1	-
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Unit Test	Mid Semester Exam
Assignments	End semester Exam

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid-Semester / Sessional Examination 1	x	x	-	-
Assignments	-	-	x	x
End Semester Exam	x	x	x	x

Feedback process:	End-Semester Feedback
Main Reference:	Singh I. Human embryology. JP Medical Ltd; [Latest Edition].

Manipal College of Health Professions	
Name of the Department	**Cardiovascular Technology (CVT)**
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Clinics - I**
Course Code	**CVT1304**
Academic Year	First
Semester	I
Number of Credits	3
Course Prerequisite	Students must know basic ECG interpretation and lead placement.
Course Synopsis	This module helps to provide a fundamental understanding of electrocardiography recording and the interpretation of ECG rhythms. This module will provide fundamental knowledge in diagnosing normal and abnormal ECG waves, cardiac electrical axis, cardiac chamber enlargement/hypertrophy, AV block, and myocardial infarction. By the end of the course, students will have a strong foundation in basic ECG concepts and be able to identify and interpret various ECG rhythms.

Course Outcomes (COs): **At the end of the course, students shall be able to**	
CO1	Build skills to demonstrate and perform basic lead placement, lead system, and patient preparation (P4)
CO2	Identify and interpret the normal ECG waves (C5, P3)
CO3	Measure the waves that would fulfill the criteria to identify abnormal ECG (C5, P3)
CO4	Compare the normal and abnormal ECG reports and Build skills to develop practical knowledge and ability to interpret given ECG (C5, P4)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		x	x		x	x		
CO2		x			x	x		
CO3		x			x	x		
CO4		x			x	x	x	

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
The conduction system of the heart	• Identify the abnormal ECG pattern in SA nodal dysfunction (C3,P3)	15

Content	Competencies	Number of Hours
	• Identify the abnormal ECG pattern in AV nodal dysfunction (C3,P3) • Identify the abnormal ECG pattern in Bundle branches(C3,P3)	
Unit 2		
Lead system	• Build skills of unipolar and bipolar lead system(C3,P4) • Build skills of lead placement (C3,P4)	5
Unit 3		
Interpretation of normal ECG	• Identify standardization(C3,P4) • Identify P wave, QRS complex, ST segment, PR interval, PR segment and QTc interval(C3,P4)	5
Unit 4		
Electrophysiology of the heart	• Develop knowledge to identify abnormal ECG pattern due to intracellular and electrical potential produced by the normal cardiac muscles (C3,P3) • Develop knowledge to identify abnormal ECG pattern due to Relative and absolute refractory period(C3,P3)	10
Unit 5		
Electrical axis	• Interpret the methods to assess ECG axis(C2,P4)	10
Unit 6		
Dextrocardia	• Identify and differentiate between True and Technical Dextrocardia (C3,P3)	5
Unit 7		
Rate and Rhythm	• Apply skills to identify sinus rhythm(C3,P4) • Apply skills to identify and compare between regular and irregular rhythm(C3,P4)	10
Unit 8		
Chamber enlargement	• Identify Right atrial enlargement(C3,P4) • Identify Left atrial enlargement(C3,P4)	10
Unit 9		
Chamber Hypertrophy	• Identify Left ventricular hypertrophy (C3,P4) • Identify Right ventricular hypertrophy (C3,P4) • Interpret and compare between volume and pressure overload in ventricular hypertrophy (C3,P4) • Identify Bi-ventricular hypertrophy(C3, ,P4)	10

Content	Competencies	Number of Hours
Unit 10		
Conduction abnormalities	• Interpret SA exit block (C2, P4) • Interpret first degree AV block (C2 ,P4) • Interpret second degree AV block(C2,P4) • Interpret third degree AV block(C2,P4) • Interpret Bundle branch block(C2,P4) • Interpret Bi and Tri-Fascicular block(C2,P4) • Interpret Bundle branch block associated with ventricular hypertrophy (C2,P4)	15
Unit 11		
Myocardial infarction	• Identify ischemia, injury, infarction(C3,P3) • Identify ST-T changes (C3,P3) • Identify changes in QRS complex (C3,P3) • Identify localization of MI(C3,P3) • Identify the culprit vessel(C3,P3) • Identify Right ventricular myocardial infarction(C3,P3) • Identify Atrial myocardial infarction(C3,P3) • Identify Myocardial infarction associated with bundle branch block(C3,P3)	25
Unit 12		
Pericarditis	• Identify Pericarditis ECG (C3,P3) • Compare pericarditis with myocardial infarction(C2,P3)	15
	Total	**135**

Learning Strategies, Contact hours and Out of class engagement					
Learning Strategies	**Contact Hours**	**Out of class engagement**			
Self-directed learning (SDL)	40	-			
Case Based Learning (CBL)	35	-			
Clinic	60	-			
Total	**135**	**135**			
Assessment Methods:					
Formative:	**Summative:**				
Clinical record book	-				
Mapping of Assessment with COs:					
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	
Clinical record book	x	x	x	x	
Feedback Process:	End-Semester Feedback				

Main Reference:	1. Leo Schamroth Textbook of Electrocardiography 2. Goldberger's Clinical Electrocardiography- A Simplified Approach 3. Marriott's Practical Electrocardiogram
Additional References	1. Marriott's practical Electrocardiography

SEMESTER - II

COURSE CODE	:	COURSE TITLE
ANA1401	:	Anatomy - II
PHY1401	:	Physiology - II
BIC1401	:	Biochemistry
CVT1401	:	Advanced ECG and Holter Monitoring
CVT1402	:	Medical Ethics & Legal Aspects
CVT1403	:	ECG Interpretation, Holter Analysis - Practicals
CVT1404	:	Clinics - II

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Anatomy - II**
Course Code	**ANA1401**
Academic Year	First
Semester	II
Number of Credits	2
Course Prerequisite	Basic knowledge of general anatomy
Course Synopsis	Human anatomy is the study of the human body andrelations of various structures of the body by dissection.

Course Outcomes (COs): At the end of the course student shall be able to	
CO1	Explain the bones, joints related to the upper, lower extremities and spine (C1, C2)
CO2	Explain the nerves related to the upper and lower extremities (C1, C2)
CO3	Explain the muscles and blood vessels related to upper, lower extremities, head and neck region (C1, C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
Pectoral region and Axilla	• Describe the pectoral muscles–pectoralis major, pectoralis minor, serratus anterior with attachments, nerve supply and actions (C1, C2) • Explain anatomical basis of winging of scapula (C2) • Describe the clavipectoral fascia (C1) • Describe the boundaries and contents of axilla (C1,C2) • Describe the axillary artery- extent, course and branches (C1, C2) • Describe the brachial plexus formation and branches (C1, C2) • Describe the Erb's point mentioning the clinical aspects (C2) • Describe the Klum pke's paralysis (C2)	3

Content	Competencies	Number of Hours
Muscles of back and shoulder region	• Describe the muscles of back and shoulder region- trapezius, deltoid, latissimus dorsi, rhomboidus major and minor, supraspinatus, infraspinatus, teres major and minor (detailed) C1, C2) • Describe the deltoid with applied anatomy (C1, C2) • Describe the supraspinatus with applied anatomy (C1, C2) • Describe the subacromial bursa with applied anatomy (C1, C2) • Describe the rotator cuff with its role in limiting shoulder dislocation (C1, C2) • Describe each of the intermuscular spaces with boundaries and contents (C1, C2)	2
Arm	• Describe the muscles of front of arm- biceps brachii, brachialis, coracobrachialis with attachments, nerve supply and actions (C1, C2) • Describe the boundaries and contents of cubital fossa (C1, C2) • Describe the brachial artery with mention of Volkmann's ischemic contracture and supracondylar fracture (C1, C2) • Describe the axillary nerve with applied anatomy(C1,C2) • Describe musculocutaneous nerve with applied anatomy (C1, C2) • Describe the triceps brachii with the nerve supply & actions (C1, C2) • Describe radial nerve with a pplied anatomy (C1, C2)	2
Forearm	• Name the superficial and deep muscles of front of forearm with nerve supply and actions (C1, C2) • Describe pronator teres and brachioradialis in detail (C1, C2) • Names the muscles of back of forearm with nerve supply and actions (C1, C2) • Describe the supinator in detail (C1, C2) • Explains tennis elbow (C1, C2) • Describe the extensor retinaculum with osseo-fascial compartments in detail (C1) • Describe the anatomical snuff box with boundaries and contents (C1, C2)	2

Content	Competencies	Number of Hours
Palm	• Describe the flexor retinaculum with applied anatomy (C1, C2) • briefly Describe the palm -name thenar and hypothenar muscles with nerve supply and action(C1) • Describe adductor pollicis (C1) • Describe the lumbricals and interossei (detailed) with nerve supply and actions (C1, C2)	1
Nerves and vessels of upper limb	• Describe the ulnar nerve with applied anatomy(C1, C2) • Describe the median nerve in detail (C1, C2) • Explains carpal tunnel syndrome detailed (C1, C2) • Describe each radial and ulnar artery- extent, course and branches (C1, C2)	3
Joints of upper limb	• Describe the shoulder joint under type, articular surfaces, ligaments, relations, movements and muscles responsible with a note on applied anatomy (C1, C2). Describe the elbow joint (detailed) (C1, C2) • Describe the radioulnar joints (detailed) (C1) • Describe the wrist joint (detailed) (C1, C2) • Describe the first carpometacarpal joint (detailed) (C1)	3
Venous and lymphatic drainage of upper limb	• Describe the median cubital vein with applied anatomy (C1, C2) • Describe the cephalic vein with applied anatomy(C1,C2) • Describe the basilic vein with applied anatomy(C1, C2) • Describe the l ymphatic drainage of upper limb (C1, C2)	1
Sternocleidomastoid and Muscles of facial expression	• Describe the sternocleidomastoid with attachments, relations, nerve supply, actions and applied anatomy (C1, C2) • Enumerates the muscles of facial expression (C1) • Describe the orbicularis oculi, orbicularis oris and buccinator with nerve supply and actions (C1, C2)	1
Vertebrae & Vertebral column	• Describe the curvatures of the vertebral column mentioning lordosis, kyphosis, scoliosis C1, (C2) • Explains the structure, functions, regional	1

Content	Competencies	Number of Hours
	characteristics of vertebrae (C1, C2) • Describe the parts and function of intervertebral disc with applied anatomy (C1, C2)	
Unit 2		
Thigh	• Describe the fascia lata, iliotibial tract, saphenous opening (C1, C2) • Describe the boundaries and content of femoral triangle (C1, C2), • Describe the femoral sheath, femoral canal with applied anatomy (C1, C2) • Describe great saphenous vein (detailed) with applied anatomy (C1, C2) • Describe the femoral artery- extent, course and branches (C1, C2) • Describe the femoral nerve with applied anatomy (C1, C2) • Describe the inguinal lymph nodes (C1) • Describe the muscles of front of thigh with attachment, nerve supply and actions (C1, C2) • Describe the adductor canal -boundaries and content with applied anatomy (C1, C2) • Describe the adductor compartment muscles with attachment, nerve supply and actions (C1, C2) • Describe the adductor magnus with attachment, nerve supply and actions (C1, C2) • Describe the obturator nerve with applied anatomy (C1, C2)	3
Gluteal region	• Describe the sensory innervation of the quadrants of gluteal region with a note on intramuscular injections (C1, C2) • Describe gluteus maximus with attachment, nerve supply and actions (C1, C2) • Describe the gluteus medius and minimus with actions and related applied anatomy (C1, C2) • Enumerate the structures under cover of gluteus maximus (C1) • Describe the relations of pyriformis with brief mention of attachment, nerve supply and actions (C1,C2)	1
Back of thigh and Popliteal fossa	• Describe the hamstring muscles with attachments, nerve supply and actions (C1, C2) • Describe the popliteal fossa with boundaries and contents (C1, C2)	1

Content	Competencies	Number of Hours
	• Describe the popliteus with emphasis on actions (C1, C2) • Describe the popliteal artery -extent, course and branches with a note on applied anatomy (C1, C2)	
Leg	• Enumerates the anterior compartment muscles with attachment, nerve supply and actions with applied anatomy (C1, C2) • Describe the tibialis anterior in detail with emphasis on actions (C1, C2) • Describe the anterior tibial artery–extent, course and branches (C1, C2) • Enumerates the lateral compartment muscles with attachment, nerve supply and actions with applied anatomy (C1, C2) • Describe the peroneal artery (C1, C2) • Enumerates the posterior compartment muscles with attachment, nerve supply and actions (C1, C2) • Describe the soleus in detail with a note on applied anatomy (C1, C2) • Describe the gastrocnemius in detail with a note on applied anatomy (C1, C2) • Describe the tibialis posterior in detail with emphasis on actions (C1, C2) • Describe the posterior tibial arter y (C1, C2)	2
Foot	• Describe the sensory innervation of the dorsum of foot (C1, C2) • Enumerates the muscles with nerve supply (C1) • Describe the dorsalis pedis artery with reference to peripheral pulse (C1, C2) • Enumerates the muscles of first and second layer of sole (C1) • Names the sensory innervation of the sole of foot (C1) • Describe the arches of foot in detail with applied anatomy (C1, C2)	2
Joints of lower limb	• Describe the hip joint under type, articular surfaces, ligaments, relations, movements and muscles responsible with a note on applied anatomy (C1,C2) • Describe the knee joint under–type, articular surfaces, ligaments, relations, movements and muscles responsible with a note on applied anatomy (C1,C2)	3

Content	Competencies	Number of Hours
	• Describe the tibiofibular joint (detailed) (C1,C2) • Describe the ankle joint (detailed) (C1, C2) • Describe the subtalar joint (detailed) (C1)	
Nerves of lower limb	• Describe the sciatic nerve under origin, root value, course, branches with applied anatomy (C1, C2) • Describe the tibial nerve under origin, root value, course, branches with applied anatomy (C1, C2) • Describe the common peroneal nerve under origin, root value, course, branches with applied anatomy (C1,C2) • Describe the deep peroneal nerve under course, branches and applied anatomy (C1, C2) • Describe the superficial peroneal nerve under course, branches and applied anatomy (C1, C2)	2
Venous and lymphatic drainage of lower limb	• Describe the great saphenous vein (detailed) with applied anatomy (C1, C2) • Describe the small saphenous vein (C1) • Describe the lymphatic drainage of lower limb with a mention of elephantiasis (C1, C2)	1
	Total	**34**

Learning Strategies, Contact Hours and Out of class engagement			
Learning Strategies	**Contact Hours**	**Out of class engagement**	
Lecture	34	34	
Revision	-	-	
Assessment	-	-	
Total	**34**	**34**	
Learning Assessment Methods:			
Formative:	**Summative:**		
Nil	Sessional Exam I / Sessional Exam II (Theory)		
	End Semester Exam (Theory)		
Mapping of Assessment with COs:			
Nature of Assessment	**CO1**	**CO2**	**CO3**
Sessional Examination 1	x	x	x
Sessional Examination 2	x	x	x
End Semester Exam	x	x	x
Feedback Process:	End-Semester Feedback		

Main Reference:	• B D Chaurasia, Human Anatomy, Volume I & II. 8th edition, CBS Publishers. • Vishram Singh. General anatomy, 3 rd edition • Handbook of General anatom y by B.D. Chaurasia.
Additional References	• Text book of Anatomy, Vishram singh, 3 rd edition • Manipal Manual of Anatomy for allied health students by Dr. Sampath Madyastha.

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Physiology - II**
Course Code	**PHY1401**
Academic Year	First
Semester	II
Number of Credits	2
Course Prerequisite	Basic knowledge of general physiology
Course Synopsis	This module provides a comprehensive knowledge about normal functions of the organ systems of the body tounderstand the physiological basis of health and disease required forhealth professionals.

Course Outcomes (COs): At the end of the course student shall be able to:	
CO1	Explain the physiology of central nervous system in maintaining homeostasis to facilitate the understanding of related disease process (C1, C2)
CO2	Describe the gastrointestinal system to understand its contribution to health and diseases (C1, C2)
CO3	Describe the role of renal system in maintenance of homeostasis to facilitate the understanding of related disease processes (C1, C2)
CO4	Explain the physiology of endocrine and reproductive system and its contribution to homeostasis to facilitate the understanding of related disease processes (C1, C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes

Topics	**Competencies**	**Number of Hours**
Unit 1: Central nervous System		
General organization of nervous system	• Outline the organization of nervous system (C1) • Outline the organization of autonomic nervous system(ANS) C1) • Enumerate the functions of ANS (C1) • Mention the functional areas of cerebral cortex and their functions (C1)	1
Receptors	• Classify sensory receptors according to type and location of stimulus, giving examples for each (C2)	1

Topics	Competencies	Number of Hours
	• Explain the property of 'specificity' and 'adequate stimulus' (C2) • Explain the property of 'adaptation' of sensory receptors (C2)	
Synapse	• Define 'synapse' (C1) • Describe the structure of a synapse (C2) • Explain the events in synaptic transmission (C2)	1
Reflexes	• Define reflex (C1) • Enumerate the components of a reflex arc with the help of a diagram (C1) • Describe the stretch reflex with the help of a diagram(C2) • Describe withdrawal reflex (C2) • Explain the importance of withdrawal reflex (C2)	2
Ascending pathways	• Outline the general organization of sensory pathways(C1) • Describe the dorsal column and lateral spinothalamic tracts with the help of labelled diagrams(C2) • Mention the different sensations that are carried by the above pathways (C1)	2
Descending pathways	• Describe the pyramidal/corticospinal tract with the help of a labelled diagram (C2) • Tabulate the differences between 'upper motor neuronlesion' and 'lower motor neuron lesion (C2)	1
Cerebellum	• Name the functional divisions of cerebellum (C1) • Enumerate the functions of cerebellum(C1) • List the clinical features of cerebellar lesion (C1) • List the clinical features of cerebellar lesion (C2)	1
Basal ganglia	• Mention the components of basal ganglia (C1) • Enumerate the functions of basal ganglia (C1) • Explain the cause and clinical features Parkinson's disease (C2) • Explain the basis of treatment of Parkinson's disease (C2)	1
Thalamus and Hypothalamus	• Mention the functions of thalamus (C1) • Explain the functions of hypothalamus (C2)	2
Cerebrospinal fluid	• Describe the formation, circulation, absorption and functions of CSF (C2) • Mention the method of collection of a sample of CSF and its indications (C1)	1

Topics	Competencies	Number of Hours
Unit 2: Gastrointestinal system		
Salivary secretion	• Mention the composition of saliva (C1)	1
& Deglutition	• Explain the functions of saliva (C2) • Describe the regulation of salivary secretion (C2) • Describe the effects of Xerostomia (C2) • Define deglutition (C1) • Explain the stages of deglutition (C2) • Describe dysphagia (C2) • Describe Achalasia cardia (C2)	
Stomach	• Describe the functions of stomach (C2) • Mention the composition of gastric juice (C1) • Describe functions of gastric juice (C2) • Describe the mechanism of secretion of hydrochloric acid (C2) • Describe the regulation of gastric juice secretion (cephalic, gastric and intestinal phases) (C2)	1
Exocrine portion of Pancreas; Liver and biliary system	• Outline the composition of pancreatic juice (C1) • Describe the functions of pancreatic juice (C2) • Describe the neural and hormonal regulation of pancreatic juice (C2) • Outline the composition of hepatic bile(C1) • Describe the functions of bile(C2) • Enumerate the functions of gall bladder(C1)	1
Small intestine and large intestine	• Describe the composition and functions of small intestinal secretions (C2) • Explain Different types of Intestinal movements and their significance (C2) • Explain different types of small intestinal movements (peristalsis and segmentation contractions) and their significance(C2) • List the functions of lar ge intestine(C1)	1
Unit 3: Renal system		
Introduction & Glomerular filtration	• List the functions of kidneys (C1) • Draw a labelled diagram of a nephron (C1) • Mention the normal value of renal blood flow (C1) • Define glomerular filtration rate(GFR) (C1) • Mention the normal value of GFR (C1) • Explain the factors influencing GFR (C2) • List the substances used for the determination of GFR (C1)	1

Topics	Competencies	Number of Hours
Reabsorption and secretion in renal tubules	• Describe tubular reabsorption of sodium, glucose and water (C2) • Define tubular load, renal threshold and tubular/transport maximum (C1) • Mention the normal values for tubular load, renal threshold and tubular/transport maximum of glucose (C1)	1
Mechanism of concentration/dilution of urine	• Describe the role of counter current multiplier and counter current exchanger in the formation of urine (C2)	1
Physiology of micturition	• Describe the nerve supply to urinary bladder (C2) • Describe the micturition reflex (C2) • List the functions of skin	1
Unit 4: General principles of endocrinology		
Introduction and Pituitary gland	• Name the major endocrine glands and their secretions(C1) • List the anterior pituitary hormones (C1) • Describe the actions of growth hormone (C2) • Describe the regulation of secretion of growth hormone(C2) • Describe the cause and clinical features of gigantism (C2) • Describe the cause and clinical features of acromegaly (C2) • Describe the cause and clinical features of dwarfism (C2) • List the hormones of posterior pituitary (C1) • Describe the actions of posterior pituitary hormones (C2) • Describe diabetes insipidus (C2)	1
Thyroid gland	• List the hormones of thyroid gland (C1) • Describe the actions of thyroid hormones(C2) • Describe the regulation of secretion of thyroid hormones (C2) • Describe the cause and clinical features of hyperthyroidism (C2) • Describe the cause and clinical features of cretinism (C2) • Describe the cause and clinical features of myxedema(C2)	2
Adrenal cortex & Adrenal medulla	• Explain the actions of glucocorticoids (C2) • Describe the regulation of secretion of glucocorticoids (C2)	1

Topics	Competencies	Number of Hours
	• Explain the causeand clinical features of Cushing's syndrome (C2) • Describe the actions of mineralocorticoids (C2) • Describe the cause and clinical features of Addison's disease (C2) • List the hormones of adrenal medulla (C1) • Mention the actions of adrenal medullary hormones (C1)	
Parathyroid gland	• Describe the actions of PTH (C2) • Describe the regulation of secretion of PTH (C2) • Describe the effects of h hypoparathyroidism (C2)	1
Endocrine Pancreas	• Describe the actions of insulin (C2)	1
	• Describe the cause and clinical features of diabetes mellitus (C2) • List the actions of glucagon (C1)	
Unit 5: Reproductive system		
Male Reproductive system	• Describe the organization of male reproductive system(C2) • Describe the structure and functions of testes (C2) • Define spermatogenesis (C1) • Describe the stages of spermatogenesis (C2) • Mention the actions of testosterone (C1) • Describe the regulation of secretion of testosterone (C2)	1
Female Reproductive system	• Describe the structure of female reproductive system(C2) • Explain the actions of Estrogen and Progesterone (C2) • Describe the ovarian changes during menstrual cycle(C2) • Describe the uterine endometrial changes during menstrual cycle (C2) • Explain the hormonal control of ovarian functions (C2) • Mention the indicators of ovulation (C1)	2
Pregnancy and Lactation; Contraceptive methods	• Enumerate the functions of placenta (C1) • Describe milk ejection reflex (C2) • Mention various contraceptive methods in males (C1) • Mention various contraceptive methods in females (C1) • Explain the mechanism of action of various contraceptive methods (C2)	1

Learning Strategies, Contact Hours and Out of class engagement				
Learning Strategies	**Contact Hours**		**Out of class engagement**	
Lecture	31		-	
Revision	4		-	
Total	**35**		**35**	
Assessment Methods:				
Formative:	**Summative:**			
Nil	Sessional Exam I / Sessional Exam II (Theory)			
	End Semester Exam (Theory)			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Sessional Examination 1	x	x	-	-
Sessional Examination 2	-	-	x	x
End Semester Exam	x	x	x	x
FeedbackProcess:	End-Semester Feedback			
Main Reference:	1. Basics of Medical Physiology- 4th Edition by D Venkatesh andHH Sudhaker			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Biochemistry**
Course Code	**BIC1401**
Academic Year	First
Semester	II
Number of Credits	3
Course Prerequisite	Basic knowledge of Biology and Chemistry
Course Synopsis	Biochemistry broadly deals with the chemistry of life and living processes. It helps in understanding the building blocks–proteins, carbohydrates, fats, nucleic acids and is necessary for allied health professions students to understand various biochemical mechanisms so as to correlate with or identify the pathological processes. Knowledge of biomolecules is necessary to understand the various laboratory investigations and their relevance in clinical practice

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Explain the classification, composition and functions of macromolecules (C2)
CO2	Describe the process of digestion, absorption and metabolism of carbohydrates and lipids (C2)
CO3	Explain protein digestion and amino acid metabolism, general concepts of nutrition, balanced diet, role of macronutrients in the maintenance of health and features of malnutrition (C2)
CO4	Explain the role of micronutrients in maintenance of health and summarize the features and investigations in diabetes mellitus and acid-base disorders (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes:

Unit	**Content**	**Competencies**	**Number of Hours**
Unit 1: ENZYMES			
At the end of this chapter, a student should be able to 1. Define the term ‘enzyme’ (C1) 2. Classify enzymes based on reaction specificity(IUBMB classification)(C2)			2

Unit	Content	Competencies	Number of Hours
		3. Give one example(names of enzymes & reaction catalyzed)for each class of enzymes(C1) 4. Define the term‘isoenzymes’ (C1) 5. Explain isoenzymes with examples(creatine kinase, lactate dehydrogenase) (C2) 6. Define the term‘proenzyme or zymogen’with pepsinogen and trypsinogen as examples(C1) 7. Describe the utility of serum enzymes as diagnostic markers(C2) 8. Mention the diagnostic utility of following enzymes(C1) • CK • ALP • AST • ALT • LDH	
Unit 2: CARBOHYDRATE CHEMISTRY			
		At the end of this chapter, a student should be able to 1. Define the term‘carbohydrates’ (C1) 2. Classify carbohydrates with examples for each class(C2) 3. Classify monosaccharides with examples based on(C2) • Number of carbon atoms • Functional groups 4. Mention the source and composition of following disaccharides(C1) • Sucrose • Lactose • Maltose 5. Classify polysaccharides based on composition with examples(C2) 6. Explain the structure of starch and glycogen with schematic representation(C2 7. List the differences between starch and glycogen(C1) 8. Mention the occurrence and functions of heparin and chondroitin sulphate(C1)	2
Unit 3: CARBOHYDRATE DIGESTION AND ABSORPTION			
		At the end of this chapter, a student should be able to 1. Describe the complete digestion of dietary polysaccharides(starch andglycogen) (C2) 2. Describe the reactions catalyzed by the following brush border enzymes(C2) • Maltase • Sucrase-isomaltase • Lactase 3. Illustrate the mechanisms of absorption of monosaccharides in the smallintestine(C2) 4. Explain the significance of including sodium chloride along with glucose inthe oral rehydration solution (C2)	2

Unit	Content	Competencies	Number of Hours
Unit 4: CARBOHYDRATE METABOLISM			
A. Glycolysis At the end of this chapter, a student should be able to 1. Define aerobic and anaerobic glycolysis(C1) 2. Mention the site and subcellular site of glycolysis(C1) 3. Describe the steps of glycolysis with all the enzymes and coenzymes ateach step(C2) 4. Mention the regulatory enzymes and list the names of hormones that regulate it in the well-fed state and starvation(C1) 5. Calculate the energetics of aerobic and anaerobic glycolysis (C2)			2
B. Gluconeogenesis			2
At the end of this chapter, a student should be able to 1. Define gluconeogenesis(C1) 2. Mention the sites & subcellular sites of gluconeogenesis(C1) 3. List the precursors for gluconeogenesis(C1) 4. List the key enzymes of gluconeogenesis(C1) 5. Describe the synthesis of glucose from pyruvate and lactate(C2) 6. Mention the regulatory enzymes and list the names of hormones that regulate it in the well-fed state and starvation(C1) 7. Explain the significance of gluconeogenesis (C2)			
C. Citric acid cycle At the end of this chapter, a student should be able to 1. Recall the reaction catalyzed by pyruvate dehydrogenase complex andmention its coenzymes(C1) 2. Mention the site and subcellular site of citric acid cycle(C1) 3. Describe the reactions of citric acid cycle with all enzymes and coenzymes(C2) 4. Mention the regulatory enzymes of citric acid cycle(C1) 5. Calculate the energetics of citric acid cycle(C2)			2
D. Glycogen metabolism At the end of this chapter, a student should be able to 1. Mention the function of glycogen in liver and muscle(C1) 2. Define glycogenesis & glycogenolysis(C1) 3. Mention the site and subcellular site of glycogen metabolism(C1) 4. Mention the fate of end products of glycogenolysis in liver(role of glucose6-phosphatase)and muscle(C1) 5. Mention the regulatory enzymes and the hormones involved in regulationin well-fed state and starvation(C1) 6. List the glycogen storage disorders mentioning their names, defects and tissues affected(Type I, V & VI) (C1)			1
Unit 5: ELECTRON TRANSPORT CHAIN AND OXIDATIVE PHOSPHORYLATION			
At the end of this chapter, a student should be able to 1. Define the electron transport chain(ETC) (C1) 2. Name the subcellular site of ETC(C1)			1

Unit	Content	Competencies	Number of Hours
		3. Describe the complexes of ETC(with their components and order of arrangement)and mention the mobile electron carriers(C2) 4. Name the inhibitors for each of the complexes of ETC(C1) 5. Define oxidative phosphorylation (C1)	
Unit 6: LIPID CHEMISTRY			
		At the end of this chapter, a student should be able to 1.Define lipids(C1) 2.Explain the functions of lipids in the body(C2) 3.Classify lipids with examples for all the subclasses(C2) 4.Classify fatty acids with examples-saturated, unsaturated(based on number of double bonds), essential fatty acids (C2)	1
Unit 7: LIPID DIGESTION, ABSORPTION AND ASSOCIATED DISORDERS			
		At the end of this chapter, a student should be able to 1. Explain the process of emulsification of lipids(C2) 2. Describe the digestion of lipids in the stomach and intestine(C2) 3. Illustrate the process of absorption of lipids(C2) 4. Define steatorrhea and list its causes (C1)	2
Unit 8: LIPID METABOLISM			
	A. De novo synthesis of fatty acids	At the end of this chapter, students should be able to 1. Mention the site and subcellular site of de novo synthesis of fatty acids(C1) 2. List the sources of acetyl CoA for de novo synthesis of fatty acids(C1) 3. Explain the reaction catalyzed by acetyl CoA carboxylase(C2) 4. Mention the regulatory enzyme and the hormones involved in regulation inwell-fed state and starvation(C1)	1
	B. Synthesis of triacylglycerol(TAG)	At the end of this chapter, students should be able to 1. Show the schematic structure of triacylglycerol(C1) 2. Mention the site and subcellular site of TAG synthesis(C1) 3. Describe the reactions of TAG synthesis(C2) 4. Mention the fate of TAG in liver and adipose tissue (C1)	1
	C. Lipolysis	At the end of this chapter, students should be able to 1. Mention the site and subcellular site of lipolysis(C1) 2. Describe the reactions of lipolysis(C2) 3. Mention the regulatory enzymes and the hormones involved in regulationin well-fed state and starvation (C1)	1
	D. Beta oxidation of fatty acids	At the end of this chapter, students should be able to 1.Define beta-oxidation(C1) 2.List the site and subcellular site of beta-oxidation(C1) 3.Describe the activation of palmitic acid(C2) 4. Explain the transport of activated palmitic acid into	2

Unit	Content	Competencies	Number of Hours
		mitochondria(carnitineshuttle) (C2) 5. Describe the reactions of beta oxidation(C2) 6. Calculate the ener getics of beta oxidation of palmitic acid (C2)	
		E. Lipoproteins At the end of this chapter, student should be able to 1. Classify lipoproteins based on their electrophoretic mobility and ultracentrifugation properties(C2) 2. Mention the site of synthesis and the functions of Chylomicrons, VLDL,LDL and HDL (C1)	1
Unit 9: AMINO ACID & PROTEIN CHEMISTRY			
		At the end of this chapter, student should be able to 1. Recognize the general structure of D and L amino acids(C1) 2. Classify amino acids based on the following with examples(C2) • Presence in proteins(standard and non-standard amino acids) • Metabolic fate(glucogenic and ketogenic amino acids) • Nutritional requirement(essential and non-essential amino acids) 3. Classify proteins based on composition, functions and shape with examples(C2) 4. Describe the structure of mature collagen with diagram(C2) 5. Explain with illustrations the biosynthesis of mature collagen emphasizing the importance of prolyl hydroxylase, lysyl hydroxylase and lysyl oxidase (C2)	3
Unit 10: PROTEIN DIGESTION AND ABSORPTION			
		At the end of the chapter, a student should be able to 1. Outline the activation of zymogens in the GIT(C1) 2. List the endo and exopeptidases in the digestive juices(C1)	1
Unit 11: AMINO ACID METABOLISM			
		At the end of the chapter, a student should be able to 1. Explain transamination of amino acids with suitable examples(C2) 2. Describe the generation of ammonia by oxidative deamination using L-glutamate dehydrogenase. (C2) 3. Study urea cycle as follows • Name its site and subcellular site(C1) • Describe its reactions(C2) • Mention its significance(C1) 4. Recall the physiologically important products derived from the followingamino acids(C1) • Glycine • Tyrosine • Methionine • Tryptophan	2
Unit 12: GENERAL CONCEPTS OF NUTRITION			
		At the end of the chapter, a student should be able to 1. Define the term balanced diet(C1) 2. Define caloric value of food and list the caloric values of	2

Unit	Content	Competencies	Number of Hours
carbohydrates,proteins and fats(C1) 3. State the total daily caloric requirements of an adult male and female(forsedentary, moderate and heavy workers)and for pregnant and lactating women(C1) 4. Define recommended dietary allowance(RDA) (C1) 5. Study basal metabolic rate as follows • Define(C1) • List the normal values for men and women(C1) • Explain the factors affecting BMR(C2) 6. Define thermic effect(SDA)of food and recall the values for macronutrients (C1)			
Unit 13: CARBOHYDRATES, PROTEINS AND FATS IN NUTRITION			
A. Carbohydrates At the end of the chapter, a student should be able to 1. Mention the RDA(C1) 2. Study dietary fibers as follows • Define(C1) • Mention its RDA(C1) • List the examples with their sources(C1) • Explain its beneficial effects(C2) **B. Proteins** At the end of the chapter, a student should be able to 1. Mention the RDA(C1) 2. Define essential amino acids with examples (C1) 3. Study biological value as follows • Define(C1) • Name the protein used as standard for determining it(C1) • List the protein sources with high and low biologic values(egg albumin,milk, fish, meat, rice, wheat and soy protein) (C1) 4. Define the term nitrogen balance(C1) 5. Explain positive and negative nitrogen balance with conditions during which they occur(C2) 6. Define the term limiting amino acids giving suitable examples(C1) 7. Explain mutual supplementation of proteins with examples(C2) **C.FATS** At the end of the chapter, a student should be able to 1. Mention the RDA(C1) 2. List the functions of cholesterol in the body(C1) 3. Study essential fatty acids as follows • Define(C1) • Mention its RDA(C1) • Explain their functions and deficiency manifestations(C2) 4. Explain saturated and unsaturated(mono and poly)fatty acids with suitable examples, mentioning its sources and functions (C2)			2

Unit	Content	Competencies	Number of Hours
Unit 14: MINERALS			
		At the end of this chapter, a student should be able to 1. Define the terms macro and micro minerals with examples. (C1) 2. Mention the sources and RDA for iron(C1) 3. Explain the functions, disorders of deficiency & excess for iron(C2) 4. Mention the sources, RDA and functions for calcium and phosphorus(C1) **5.** Mention the normal serum levels of calcium and phosphorus and the hormones which regulate it **(**C1**)**	2
Unit 15: VITAMINS			
		At the end of this chapter, a student should be able to 1. Define the term vitamins(C1) 2. List the classes of vitamins based on solubility(C1) 3. Study the water soluble vitamins mentioned below • Thiamine • Riboflavin • Niacin • Pantothenic acid • Pyridoxine • Biotin • Cobalamin • Folic acid • Ascorbic acid as follows • List the RDA, sources and coenzyme forms(C1) • Describe the biochemical functions(C2) • List the features of disorders associated with their deficiencies(C1) 4. Study the fat soluble vitamins A, D, E, K as follows • List the RDA, sources and chemical forms. (C1) • Describe the biochemical functions. (C2) • List the features of disorders associated with their deficiencies and excess. (C1)	3
16. MALNUTRITION			
		At the end of this chapter, a student should be able to 1. Define the classes of protein energy malnutrition. (C1) 2. Compare the similarities and differences between marasmus and kwashiorkor (C2)	1
17. CLINICAL BIOCHEMISTRY			
		A. GLUCOSE HOMEOSTASIS AND DIABETES MELLITUS At the end of this chapter, a student should be able to 1. Summarize the effect of the hormones involved in blood glucose homeostasis(C2) 2. Study diabetes mellitus as follows • Define(C1)	2

Unit	Content	Competencies	Number of Hours
		• Classify and compare the types 1 and 2(C2) • Mention the signs and symptoms(C1) • Mention the normal plasma levels of fasting, postprandial and random glucose & their utility in diagnosis(C1) • Explain the relevant investigations involved in the diagnosis and management(HbA $_{1C}$, procedure and interpretation of GTT, microalbuminuria) (C2) • Explain the biochemical basis for features of diabetic ketoacidosis(C2)	
		B. SIGNIFICANCE OF ESTIMATIONS OF VARIOUS BIOCHEMICAL PARAMETERS IN BLOOD At the end of this chapter, a student should be able to **1.**Mention the normal serum levels of glucose, protein, urea, uric acid, bilirubin, cholesterol and creatinine and conditions in which they are altered**(**C1**)**	1
		C. ACID BASE BALANCE AND DISTURBANCES At the end of this chapter, a student should be able to: 1. Define the terms acid, base, pH and pKa(C1) 2. Study buffers as follows • Define(C1) • Write the Henderson-Hasselbalch equation for different buffer systems(C1 • List the principal buffer systems in ECF, ICF and in urine(C1) • Mention the pKa value, normal ratio of base/acid in the plasma for bicarbonate and phosphate buffer systems(C1) 3. Study acid-base disorders as follows • Define the different classes(C1) • Explain the conditions causing acidosis & alkalosis(metabolic & respiratory) (C2) 4. Mention the primary and compensatory changes in acid base disorders (C1)	1
Unit 18: MOLECULAR BIOLOGY			
		At the end of this chapter, a student should be able to	2
		1. Name the purine and pyrimidine bases(C1) 2. Define nucleosides and nucleotides with examples(C1) 3. Illustrate the Watson and Crick model of B-DNA structure(C2) 4. List the different types of RNA(C1) 5. Recall the structural differences between DNA and RNA(C1) 6. Define re plication, transcription and translation (C1)	

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	45	-
Assessment	4	-
Total	**49**	**49**

Assessment Methods:	
Formative:	**Summative:**
Nil	Sessional Exam I / Sessional Exam II (Theory)
	End Semester Exam (Theory)

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Sessional Examination 1	x	x	-	-
Sessional Examination 2	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End Semester Feedback
Main Reference:	1. Essentials of Biochemistry, U satyanarayana, UChakrapani (2nd edition) 2. Handbook of Biochemistry for Allied & NursingStudents, Shivananda Nayak B (2nd edition)

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Advanced ECG and Holter Monitoring**
Course Code	**CVT1401**
Academic Year	First
Semester	II
Number of Credits	4
Course Prerequisite	Knowledge about basic ECG and interpretation
Course Synopsis	This module covers analyzing and interpreting cardiac electrograms in arrhythmias and other complex cardiac disease conditions. This course includes mechanism, classification, and ECG interpretation of tachy-arrhythmias, and miscellaneous ECG findings. By the end of the course, students will gain proficiency in ECG interpretation and be able to apply their knowledge in real-world clinical settings

Course Outcomes (COs): At the end of the course student shall be able to:	
CO1	Understand the genesis of cardiac arrhythmias(C2)
CO2	Identify and analyze the ECGs of premature complexes, tachyarrhythmias, and bradyarrhythmias, including narrow and broad complex arrhythmias(C4)
CO3	Interpret and analyzing the ECGs in miscellaneous cardiac conditions and cardiac pacemaker rhythm(C4)
CO4	Understand the role of ambulatory ECG recording and its analysis and interpretation(C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x					x		
CO2	x					x		
CO3	x					x		
CO4	x					x		

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1		
Genesis of cardiac arrhythmias	• To understand and explain the genesis of cardiac arrhythmias (C2) • To understand and explain the Automaticity (C2) • To understand and explain the Triggered activity (C2) • To understand and explain the Re-entry mechanism(C2)	6

Content	Competencies	Number of Hours
Unit 2		
Premature complexes	• To identify and interpret the ECGs of Premature beats/Bigeminy/Trigeminy (C3) • To identify and interpret the ECGs of Atrial ectopics (C3) • To identify and interpret the ECGs of Junctional ectopics (C3) • To identify and interpret the ECGs of Ventricular ectopics (C3)	7
Unit 3		
Narrow complex arrhythmias	• To understand the classification of Narrow complex tachycardia (C2) • To Interpret and analyse the ECGs of Atrial fibrillation (C3) • To Interpret and analyse the ECGs of atrial flutter and Multifocal atrial tachycardia(C3) • To Interpret and analyse the ECGs of AVRT and its types(C3) • To Interpret and analyse the ECGs of AVNRT and its types(C3)	8
Unit 4		
Broad complex arrhythmias	• To Interpret and analyse the ventricular Tachyarrhythmias in structurally normal heart (C4) • To Interpret and analyse the ventricular Tachy arrhythmias in structurally abnormal heart (C4) • To interpret and analyse the ECGs of Ventricular fibrillation (C4) • To Interpret and analyse the ECGs of Torsade D pointes(C4)	8
Unit 5		
Approach to broad complex tachycardia	• To understand and differentiate VT from SVT with aberrancy(C4) • To understand VT v/s SVT with aberrancy algorithms(C4)	5
Unit 6		
Pacemaker rhythm	• To Interpret and analyse the cardiac pacemaker rhythm on ECGs(C4)	5
Unit 7		
ECG in miscellaneous condition	• Interpret and analyse the ECGs in Cardiomyopathies (C4) • Interpret and analyse the ECGs in Myocarditis (C4) • Interpret and analyse the ECGs in Pulmonary thrombo embolism (C4) • Interpret and analyse the ECGs in electrolyte imbalance (C4)	8

Content	Competencies	Number of Hours
	• Interpret and analyse the ECGs in Brugada syndrome (C4)	
Unit 8		
Ambulatory ECG	• To explain the lead system in ambulatory ecg monitoring(C2) • The explain the role of ambulatory ECG recording and its analysis and interpretation with Indications (C2)	6
Unit 9		
Signal averaged ECG	• To understand the role of signal averaged ECG and its Indications, Lead system (C2) • To Analyse and interpret signal averaged ECG (C3)	4
Unit 10		
Pitfalls of ECG	• To explain the pitfalls of ECG interpretation (C3)	3
	Total	**60**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	47	-
Assignment	8	-
Revision	3	-
Assessment	2	-
Total	**60**	**60**

Assessment Methods:	
Formative:	**Summative:**
Unit test	Mid-semester Exam
Assignment	End-semester Exam

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid-Semester / Sessional Examination 1	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Schamroth L. An Introduction to Electrocardiography. Wiley-Blackwell. 2. Goldberger's Clinical Electrocardiography

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Medical Ethics and Legal Aspects**
Course Code	**CVT1402**
Academic Year	First
Semester	II
Number of Credits	2
Course Prerequisite	NIL
Course Synopsis	This course will explore the major ethical issues confronting the practices of medicine. The study of ethics prepares healthcare students to recognize difficult situations and to deal with them in a rational and principled manner

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Apply the principles of medical ethics in day to day practice (C2)
CO2	Comprehend the concepts of medical ethics and practice the codes of conduct for healthcare professionals (C1)
CO3	Choose the right course of action among available choices by recognizing ethical issues that may arise during patient care(C2)
CO4	Recognize the skills needed to act professionally after making the right choices appropriately in a given situation (C1)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1				x			x	
CO2				x	x			
CO3			x	x	x		x	
CO4			x	x				x

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1		
Principles of medical ethics	• Define and Explain Beneficence(C2) • Define and Explain Non-maleficence(C2) • Define and Explain Autonomy(C2) • Define and Explain Justice(C2) • Define and Explain Veracity(C2) • Define and Explain Confidentiality(C2)	3
Unit 2		
Medical Malpractice and	• What is medical malpractice(C1) • Mention the types of medical malpractice(C1)	3

Content	Competencies	Number of Hours
Medical Negligence	• Examples of medical malpractice(C2) • Definition of negligence and medical negligence(C2) • Action for medical negligence(C2) • Types of medical negligence with examples(C2) • Indian Penal code and medical negligence(C2)	
Unit 3		
Autonomy of the Patient Vs Paternalism	• Brief overview of Autonomy of patient (C2) • Mention the types of Paternalism(C1) • Define and Explain Justifiable Paternalism(C2) • Understand the Models of doctor-patient relationship(C2)	3
Unit 4		
Informed consent	• Definition of Informed consent (C1) • Mention the types of consent (C1) • Legally Valid Consent(C2) • Consent under special circumstances(C2) • Informed consent: Definition, why informed consent is necessary, Exceptions to fully informed consent, Elements of fully informed consent, Issues involved in informed consent(C2) • Understanding the cases of Medical Negligence related to Consent(C2)	3
Unit 5		
Confidentiality and patient rights	• Definition of Confidentiality(C1) • Need of Confidentiality(C1) • Confidentiality and Related Code of Conduct(C2) • Breach of confidentiality: Definition, Situations of Breach of confidentiality, Circumstances in which confidentiality might be breached for ethically or legally justifiable (C2) • Expalining the importance of Special attention must be given to safeguard the release of information(C2) • Disclosure of patient information (C2) • Understanding the Fundamentals of confidentiality in research(C1) • Understanding the Cases of Confidentiality(C1)	3
Unit 6		
Medico-Legal Aspects of Health records	• Definition of MLA (C1) • Types of MLA (C1) • Procedure of registering medico-legal case(C2)	3

Content	Competencies	Number of Hours
	• Expalin the steps in Receiving an MLC(C2) • To understand the time limit for registering medicolegal case(C2) • Understanding the precaution to be taken for registering a medico-legal case(C2) • Define Medico-legal case report(C1) • Explain Medico-legal aspects of health records (C2) • Define Ownership of medical records(C2) • To explain the Confidentiality of health information (C2) • To explain the disclosure of health information (C2) • To understand the unauthorized disclosure and safeguard against them(C2) • To Define Retention of medical records(C1) • To understand the Medical records and court of law in Indian Context(C2)	
Unit 7		
Irrational Drug Therapy	• Define Drugs and Rational Drug Therapy(C1) • To define rational Drug Therapy(C1) a. Prescribing can be irrational under variety of condition b. Common patterns of irrational prescribing may be manifested in the following forms: c. Factors Underlying Irrational Use of Drugs d. Impact of Inappropriate Use of Drugs • To understand the Strategies for the Promotion of Rationale Use of Drug(C2) • To understand the World Health Organization advocates 12 key interventions to promote more rational use(C2) • Define Drug Legislation for Rational Drug Policy(C1) • To understand the, The Drug and Cosmetic Act,1940(C2) • To understand the Drugs and Magic Remedies (Objectionable Advertisements) Act, 1955(C2) • To define drug Promotion(C2)	3
Unit 8		
Human Organ and Tissue Transplantation	• To understand the.Important Aspect of organ donation (C2) • To understand the Allocation of Organs(C2) • To understand the Ethics in Allocation of Organs for Transplantation in Humans(C2)	3

Content	Competencies	Number of Hours
Unit 9		
Research, Human Experimentation and Technology in health care	• To understand the Ethics in Human Research(C2) • To Explain International Instruments and Guidelines(C2) • Define Declaration of Helsinki(C1) • To understand the Basic Principles of all Medical Research(C2) • To understand the Indian Council for Medical	2
Unit 10		
Ethical Issues at the beginning and end of life	• To define Right to life(C1) • To understand Sex Pre- selection: Female foeticide & Infanticide(C2) • To define Assisted Reproductive Technologies (C2) • To define Care of Terminally ill patient(C1) • Define Euthanasia(C1) • Define Quality of life(C1)	2
Unit 12		
Consumer Protection Act	• To understand Consumer Protection Act, 1986(C2) • To explain the Objectives(C2) • The salient features of the Act (C2) • To understand the Consumer Protection Act & Rights of Consumers(C2) • To understand the Needs and Application of Consumer Protection Act to the medical services(C2) • To understand the Consumer Protection Act Forums & Commissions(C2) • To explain Period of limitation (C2) • To understand the Advantages & Disadvantage of CPA(C2)	2
	Total	**30**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	22	-
Seminar	4	-
Revision	2	-
Assessment	2	-
Total	**30**	**30**

Assessment Methods:	
Formative:	**Summative**:
Unit Test	Mid Semester/Sessional Exam (Theory)
Assignments/Presentations	

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	-	-
Assignments/Presentations	-	-	x	x

Feedback Process:	End-Semester Feedback
Reference:	1. Medical Ethics 3rd Edition by CM Francis 2. Medical Ethics and Law 3rd Edition by Dominic Wilkinson, Jonathan Herring and Julian Savulescu

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**ECG Interpretation, Holter Analysis -Practicals**
Course Code	**CVT1403**
Academic Year	First
Semester	II
Number of Credits	4
Course Prerequisite	A better understanding of the fundamental understanding of interpreting basic electrocardiograms and correctly positioning the leads.
Course Synopsis	This course trains students in ECG interpretation and Holter analysis. It covers the conduction system, lead systems, normal ECG criteria, electrical axis, rhythm/rate abnormalities, chamber enlargement, conduction disturbances, myocardial infarction, pericarditis, premature complexes, and narrow/broad complex tachyarrhythmias. Students gain practical skills in identifying ECG changes across various conditions and interpreting ambulatory Holter recordings.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	To build knowledge on interpretation of normal ECG. (C3)
CO2	Describe and utilize the abilities required for conducting an ECG. (C2, P2)
CO3	Interpret abnormal ECGs as well as compare normal and abnormal ECG findings. (C4, P1)
CO4	To build knowledge on the lead system and analysis and interpretation of the Holter monitor report. (C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1		x				x		
CO2		x			x			
CO3		x				x	x	x
CO4		x				x		

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1		
Basics in ECG	• Build skills of unipolar and bipolar lead system and lead placement (C3,P4) • To identify the standardization, the normal P	20

Content	Competencies	Number of Hours
	wave, PR interval, QRS duration, QTc interval (C3,P4) • Interpret the methods to assess ECG axis(C2,P3) • Identify and differentiate between true and technical dextrocardia(C3,P3) • Apply skills to identify the sinus rhythm and to identify the differences between regular and irregular rhythm(P3)	
Unit 2		
Chamber enlargement/ Hypertrophy	• Analyse Right and Left atrial enlargement ECG(C4,P4) • Analyse and interpret left and right ventricular hypertrophy(C4,P4) • Analyse and distinguish between volume and pressure overload of ventricular hypertrophy(C4,P4)	15
Unit 3		
Conduction abnormalities	• Evaluate first, second and third degree AV block(C5,P4) • Evaluate left and right Bundle branch block(C5,P4) • Evaluate Bifascicular and trifascicular block(C5,P4) • Evaluate bundle branch block associate with ventricular hypertrophy(P4)	20
Unit 4		
Sick sinus syndrome	• Able to perform and analyze the ECG findings of Brady -tachy arrhythimas (C4, P4) • Identify the difference between brady arrhythmias such as sinus exit blocks sinus arrhythmia, and sinus pause (C3	5
Unit 5:		
ECG in Myocardial Infarction and Miscellaneous condition	• Distiguish between ischemia, injury and infarction ECG patterns(C5,P3) • Identify the different stages of MI(C3,P3) • Identify the culprit vessel and interpret localisation of MI(C5,P3) • Interpret Right ventricular and atrial myocardial infarction(C5,P3) • Myocardial infarction associated with bundle branch block (C5,P3) • Interpret ECG in different types of	15

Content	Competencies	Number of Hours
	cardiomyopathies(C5,P3) • Identify and interpret pulmonary thromboembolism(P3) • Recall and interpret different types of electrolyte imbalance ECGs(P3) • Identify the pericarditis ECG and distinguish myocardial infarction ECG (C3,P3)	
Unit 6		
Premature complexes	• Identify and interpret atrial, junctional, ventricular ectopics(C5,P3)	10
Unit 7		
Narrow complex tachycardia	• Make use of algorithm to diagnose and approach Narrow Complex Tachycardia based on the regurality (C3,P3) • Interpret Sinus, junctional Atrial, Paroxysmal junctional atrial / low atrial tachycardia (C5,P3) • Interpret Atrial fibrillation, Atrial Flutter Multifocal atrial tachycardia (C5,P3) • Interpret WPW, LGL syndrome (C5,P3) • Identify and distinguish between anti/ortho-dromic conduction in AVRT(P3) • Identify and distinguish between typical/atypical AVNRT(P3)	20
Broad complex tachycardia	• Make use of algorithm to diagnose and approach ventricular arrhythmia (C3,P4) • Interpret ventricular tachycardia, ventricular fibrillation, Torsades de pointes(P3) • Distinguish between ventricular tachycardia and Supraventricular tachycardia(C3,P3)	
Unit 8:		
Ambulatory ECG recording (HOLTER)	• Recall indications(C1,P3) • Perform lead placement system(P4) • Analysis and interpretation of holter reports(C5,P4) Analyze and distinguish between volume and pressure overload of ventricular hypertrophy (C4, P4)	15
	Total	120

Learning Strategies, Contact Hours and : Out of class engagement :					
Learning Strategies	**Contact Hours**	**Out of class engagement**			
Self-directed learning (SDL)	50	-			
Problem Based Learning (PBL)	40	-			
Case Based Learning (CBL)	20	-			
Practical	5	-			
Assessment	5	-			
Total	**120**	**120**			
Assessment Methods:					
Formative:	**Summative:**				
Quiz/ Viva	Mid-Semester Practical Exam				
Assignments/Presentations	End semester Practical Exam				
Mapping of Assessment with COs:					
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	
Mid Semester Exam	x	x	-	-	
Quiz / Viva	-	-	x	x	
Assignments/Presentations	x	x	x	x	
End Semester Exam	x	x	x	x	
Feedback Process:	End-Semester Feedback				
Main Reference:	1. Schamroth L. An Introduction to Electrocardiography. Wiley-Blackwell; 2020 (8th Edition). 2. Ary Louis Goldberger. Clinical Electrocardiography. Mosby Incorporated; 2017. (9th Edition).				

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Clinics - II**
Course Code	**CVT1404**
Academic Year	First
Semester	II
Number of Credits	3
Course Prerequisite	Basic knowledge of ECG interpretation and lead placement
Course Synopsis	This course thoroughly explains advanced ECG techniques, including narrow and broad complex arrhythmia and their clinical applications. ECG in miscellaneous conditions, lead placement, Holter monitoring interpretation, and signal-averaged ECG will also be practiced. By the end of the course, students will be able to confidently identify and interpret complex ECG patterns and understand the implications of ECG findings for patient care

Course Outcomes (COs): **At the end of the course, students shall be able to:**	
CO1	Build skills and perform Basic lead placement, importance, and patient preparation (C1, P4)
CO2	Perform and distinguish the changes between normal and abnormal cardiac rhythm (C4, P4)
CO3	Perform and interpret various abnormal narrow and broad complex tachyarrhythmias in ECG (C5, P4)
CO4	Perform and analyze ambulatory ECG recording (HOLTER) and signal-averaged ECG.(C4, P4)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x	x						
CO2	x	x						
CO3		x					x	
CO4		x					x	

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1:		
Premature beats/Bigeminy/ Trigeminy	• Perform and analyze the ECG in Atrial Ectopic rhythm (C4, P4) • Perform and identify the ECG changes in	10

Content	Competencies	Number of Hours
	Junctional ectopic rhythm (C3, P4) • Perform and interpret the ECG changes in Ventricular ectopic rhythm (C2,P4)	
Unit 2:		
Narrow complex tachycardia	• Perform and able to distinguish the difference between Regular/ irregular ECG (C4, P4) • Perform and interpret the ECG in Sinus tachycardia (C2, P4) • Perform and interpret the ECG in Junctional tachycardia (C2, P4) • Perform and distinguish the difference between Atrial tachycardia/ PJAT/ Low atrial tachycardia ECG (C4, P4) • Perform and interpret the ECG in Multifocal atrial tachycardia (C2,P4)	10
Atrial fibrillation	• Perform and interpret the ECG changes of atrial fibrillation (C2,P4)	5
Atrial flutter	• Perform and identify the ECG changes in atrial flutter (C3, P4)	5
AVRT	• Perform and interpret the ECG in WPW syndrome (C2, P4) • Perform and identify the ECG findings in LGL syndrome (C3, P4) • To perform and analyze the ECG findings of Anti-dromic/ orthodromic conduction in AVRT (C4, P4)	10
AVNRT Typical/ atypical AVNRT	• Perform and identify AVNRT ECG (C3, P4) • Perform and distinguish between Typical and atypical AVNRT (C4,P4)	5
Approach to narrow complex tachycardia	• Able to identify the ECG changes in narrow complex tachycardia ECG (C3) • Distinguish between narrow and broad complex tachycardia.(C4)	5
Unit 3:		
Ventricular tachycardia	• Perform and interpret the difference between VT in structurally normal heart and abnormal heart (C5, P4) • To understand and make use of algorithms of Ventricular arrhythmia (C3) • To perform and able to interpret the ECG findings of Ventricular fibrillation (C2, P4) • Perform and interpret the ECG findings of Torsade D Pointes (C2, P4)	10
Fascicular VT	• Perform and analyse the ECG findings of fascicular VT (C4,P4)	5

Content	Competencies	Number of Hours
Approach to broad complex tachycardia VT vs SVT with aberrancy	• Interpret the difference between VT and SVT aberrancy (C5)	5
Unit 4:		
Sick sinus syndrome	• Able to perform and analyze the ECG findings of Brady -tachy arrhythmias (C4, P4) • Identify the difference between brady arrhythmias such as sinus exit blocks sinus arrhythmia, and sinus pause (C3)	5
Pacemaker rhythm	• Able to perform and distinguish between normal and pacemaker rhythm ECG (C4, P4) • Perform and identify the types of pacemaker rhythm and interpret (C4,P4)	5
Unit 5:		
ECG in miscellaneous conditions	• Able to perform and identify the types of cardiomyopathies (C3, P4) • Interpret and distinguish the ECG findings of hypertrophic, restrictive cardiomyopathy ECG (C4, C5) • Perform and interpret ECG findings of Myocarditis (C5, P4) • Perform and interpret the ECG findings in pulmonary thromboembolism (C4 ,P4) • To recall the basic knowledge about electrolyte imbalance (C1) • Perform and identify ECG findings in electrolyte imbalance (C3,P4)	20
Brugada syndrome	• Able to perform and identify the ECG changes in Brugada syndrome (C3, P4) • Able to identify a differential diagnosis of Brugada syndrome (C3,P3)	5
Unit 6		
Ambulatory ECG recording (HOLTER)	• To build the normal lead system in Ambulatory recording (HOLTER) and patient preparation (C3) • Perform and analyze the Holter Monitoring report (C4, P4)	10
Signal averaged ECG	• To build knowledge about the normal lead systems in signal-averaged ECG, Patient preparation (C3) • Perform and analyze the signal average ECG (C4,P4)	10
Unit 7:		

Content	Competencies	Number of Hours
Pitfalls in ECG Interpretation	• Identify the various pitfalls in ECG lead placement (C3, P3) • Able to evaluate the pitfalls in ECG interpretation (C5) • Able to correct the changes and interpret it(C5)	10

Learning Strategies, Contact Hours and Out of class engagement :					
Learning Strategies	**Contact Hours**	**Out of class engagement**			
Self-directed learning (SDL)	40	-			
Case Based Learning (CBL)	35	-			
Clinic	60	-			
Total	**135**	**135**			
Assessment Methods:					
Formative:	**Summative**:				
Clinical Record Book	-				
Mapping of Assessment with COs:					
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	
Clinical Record Book	x	x	x	x	
Feedback Process:	End-Semester Feedback				
Main Reference:	1. Leo Schamroth Textbook of Electrocardiography 2. Goldberger's Clinical Electrocardiography- A Simplified Approach 3. Marriott's Practical Electrocardiogram				
Additional References	1. Marriott's Practical Electrocardiography				

SEMESTER - III

Course Code	:	Course Title
MCB2303	:	Microbiology
PAT2303	:	Pathology
CVT2301	:	Ultrasound Physics and Doppler Principles
CVT2302	:	Cardiac Stress Tests
CVT2303	:	Cardiac Instrumentations
CVT2304	:	Clinics - III
*** ****	:	Open Elective - I

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Microbiology**
Course Code	**MCB2303**
Academic Year	Second
Semester	III
Number of Credits	03
Course Prerequisite	Nil
Course Synopsis	This course focuses on acquiring the knowledge pertaining to basics of medical microbiology, host immune response, common infectious diseases prevalent in India, healthcare associated infections and aseptic measures to prevent infections

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Explain the process of disease causation by infectious agents and appraise the role of microbiology laboratory in the diagnosis, management and control of infectious diseases with an emphasis on diseases prevalent in India (C2)
CO2	Explain the development of immune response, its relation to infection and other diseases with an immunological basis (C2)
CO3	Explain the implications of antibiotic susceptibility (C2)
CO4	Understanding the principles of asepsis and infection control in clinical practice (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Introduction To Medical Microbiology	i) Historical introduction to microbiology a. Describe the contributions of: (C1) • Louis Pasteur • Robert Koch ii) Classify the microorganisms (C2) iii) List the branches of microbiology and their	1

Content	Competencies	Number of Hours
	significance (C1)	
Bacterial Anatomy And Classification	i) Explain the bacterial cell structure, organelles and their functions (C2) ii) Explain the bacterial envelope of gram positive and gram negative bacteria (C2) iii) Explain the following bacterial structure and their significance (C2) a. Cytoplasm b. Ribosomes c. Mesosomes d. Nucleoid e. Inclusion granules f. Flagella g. Pili h. Capsule i. Plasmid j. Spores iv) Classify bacteria based on morphology and nutrition (C2)	2
Growth, Cultivation And Identification Of Bacteria	i) Explain the following: (C2) a. Bacterial growth curve b. Cultivation of bacteria • Culture media • Culture methods c. Identification of bacteria • Microscopy and Staining techniques • Biochemical reactions • Serology • Molecular techniques	2
Antimicrobial Susceptibility	i) Explain the disc diffusion methods – Kirby Bauer's and E - test (C2)	1
Introduction to Virology, Mycology & Parasitology	i) Explain the following: (C2) a. General features of viruses b. Virion structure c. Classification of viruses d. Diagnosis of viral diseases e. General properties and classification of fungi (morphological classification) f. Infections produced by fungi and their diagnosis g. General properties and classification of parasites h. Parasitic infections and their diagnosis	3
Sterilization and Disinfection	i) Classify sterilization methods (C2) ii) Explain the following (C2) a. Physical: Heat	3

Content	Competencies	Number of Hours
	b. Sterilization by heat c. Dry heat sterilization – • Hot air oven and incinerator d. Moist heat sterilization • Below 100 ^{o}C, • At 100 ^{o}C • Above 100 ^{o}C e. Classification of disinfectants used in hospital and their mechanism of action	
Infection & Immunity	i) Define infection (C1) a. List the types, sources, routes and spread of infectious diseases (C1) ii) Define and classify immunity (C1) iii) Explain the following: (C2) a. Types of immunity b. Types of vaccines iv) List the immunization schedule in India (C1)	2
Antigen & Antibody	i) Define antigen (C1) ii) Define(C1) and classify antibodies (C2) iii) Explain the following (C2) a. Functions of antibodies b. Diagnostic importance of antigen-antibody reactions • Agglutination • Immunofluorescence • ELISA	1
Immune Response	i) List the cells of immune system (C1) ii) Explain the following: (C2) a. Humoral Immunity – Primary and secondary immune response b. Cell mediated Immunity -Constituents and significance	2
Hypersensitivity	i) Define (C1) and classify hypersensitivity (C2) ii) Explain the following: (C2) a. Immediate hypersensitivity • Mechanisms and mediators of Anaphylaxis and atopy b. Cytotoxic hypersensitivity - Mechanism and associated disorders c. Immune complex hypersensitivity- • Arthus reaction, serum sickness and immune complex diseases d. Delayed type hypersensitivity- Mechanism and clinical importance of • Contact dermatitis and tuberculin type hypersensitivity	2

Content	Competencies	Number of Hours
Autoimmunity	i) Define autoimmunity (C1) ii) Explain the mechanisms of autoimmunity (C2) iii) List the diseases involving predominantly one type of cell or organs (C1) iv) List the diseases involving multiple organs (systemic) (C1)	1
Healthcare Associated Infections	i) Listthe common Healthcare associated infections (C1) ii) Explain the following: (C2) a. Causes b. Sources c. Routes of spread d. Host risk factors e. MRSA and its importance f. Prevention g. Investigation	1
Standard Precautions And Overview Of Laboratory Diagnosis Of Microbial Infections	i) Explain the following (C2) a. Hand hygiene b. Personal protective equipment (PPE) c. Respiratory hygiene d. Sharp safety e. Sterile instruments and devices. f. Clean and disinfected environmental surfaces ii) Explain laboratory diagnosis of microbial infections (C2) a. Specimen Collection b. Specimen transport c. Specimen processing and handling d. Identification of microbes	3
Respiratory Tract Infections	i) Bacterial pneumonia a. List the causative agents associated (C1) b. Explain the pathogenesis and laboratory diagnosis of the following organisms (C2) • Streptococcus pneumoniae • Haemophilus influenzae • Klebsiella pneumoniae c. Describe the preventive measures(C1) ii) Viral pneumonia a. List the causative agents (C1) • Influenza b. Explain the etio-pathogenesis (C2) c. Explain the lab diagnosis (C2) d. Describe the preventive measures(C1) iii) Tuberculosis a. Describe the general properties of etiological agent (C1)	3

Content	Competencies	Number of Hours
	b. Explain the pathogenesis (C2) c. Explain the lab diagnosis (C1) **d.** Describe the preventive measures (C1)	
CNS Infections	i).Acute bacterial meningitis a. List the causative agents (C1) b. Explain the pathogenesis(C2) c. Explain the laboratory diagnosis(C2) d. Describe the preventive measures (C1) ii). Poliomyelitis a. Describe the general properties of etiological agent (C1) b. Explain the pathogenesis (C2) c. Explain the preventive measures (C2) iii). Tetanus a. Describe the general properties of etiological agent (C1) b. Explain the pathogenesis (C2) c. Explain the laboratory diagnosis (C2) d. Describe the preventive measures (C1)	3
Skin & Muscle Infections	i) Explain the etio-pathogenesis and laboratory diagnosis of following agents: (C2) a. Staphylococcus aureus b. Streptococcus pyogenes c. Clostridium perfringens	3
Cardiovascular System Infections	i) Infective endocarditis and Acute Rheumatic Fever (ARF) a. List the etiological agents (C1) b. Explain the pathogenesis and laboratory diagnosis of infective endocarditis and ARF (C2) c. Describe the preventive measures of ARF(C1) ii) Pyrexia of Unknown Origin (PUO) a. Define (C1) and classify (C2) b. Explain the investigation of classical PUO (C2)	2
GIT Infections	i) List the agents causing food poisoning and food associated infections (C1) ii) Explain the etio-pathogenesis and laboratory diagnosis of the following:(C2) a. Escherichia coli diarrhoea b. Cholera c.Bacillary dysentery d. Enteric fever iii) Describe the preventive measures of cholera and enteric fever (C1) iv) Explain the morphology, transmission, clinical	6

Content	Competencies	Number of Hours
	features and laboratory diagnosis of following parasites (C2) a. Entamoeba histolytica b. Ascaris lumbricoides **c.** Ancylostoma duodenale v) Viral hepatitis a. List the etiological agents (C1) b. Explain the transmission, pathogenesis, laboratory diagnosis and prevention of HBV infection(C2)	
Urogenital Infection	**i) URINARY TRACT INFECTION** a. List the etiological agents (C1) b. List predisposing factors – Host factors and Microbial factors (C1) c. Explain the clinical features and laboratory	2
	diagnosis (C2) **ii) SEXUALLY TRANSMITTED DISEASES** a. List the organisms causing STDs (C1) b. Human immunodeficiency virus infections • Explain general properties, pathogenesis, clinical features complications and laboratory diagnosis (C2)	

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	40	80
Revision	2	-
Assessment	3	10
Total	**45**	**90**

Assessment Methods:	
Formative:	**Summative:**
Unit Test- Nil	First Sessional Examination SEQ (theory) Second Sessional Examination – SEQ (theory)
Quiz - Nil	University Examination – SEQ theory

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester / Sessional Examination 1	x	x		
Sessional Examination 2			x	x
End Semester / University Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	Textbook of Microbiology for Dental students, Prof: C.P. Baweja Medical Parasitology, D. R. Arora and D. Arora
Additional References	Review of Medical Microbiology and Immunology by Warren Levinson, 15th Edition

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Pathology**
Course Code	**PAT2303**
Academic Year	Second Year
Semester	III
Number of Credits	03
Course Prerequisite	Nil
Course Synopsis	This module is devoted to the structural and functional changes in cells, tissues and organs that underlie disease. Pathology examines diseases and their mechanisms including the what, when, where, why and how of disease. It forms an integral part of clinical medicine and allied streams, as it is required to understand the symptoms and signs of disease, the modes of diagnosis and the rationale for clinical care.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	To demonstrate their understanding of the basic principles of pathology both as a medical science and as a clinical discipline (C2)
CO2	To explain the disease mechanisms, which include basic concepts, inflammation and neoplasms of specific systems and organs, and haematological conditions and understand the significance of the mechanisms in the health profession education (C2)
CO3	To use the principles of laboratory tests in the diagnosis of diseases (C4)
CO4	To apply the knowledge of Pathology to clinical situations for understanding the disease process along with clinical manifestations and relate the relevance of knowledge of pathology to the practice of health profession (C4)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes:

Content	Competencies	Number of Hours
Unit 1: Basic concepts and general pathology		
Introduction to pathology & basic terminologies	**Terminologies** 1. Introduction to pathology 2. Recognise the relevance of Pathology (C2) 3. Define the basic terminologies and branches of Pathology (C1) a. Aetiology b. Pathogenesis c. Pathological andclinical manifestations d. Complications & sequelae e. Prognosis f. Syndrome g. Lesion 4. Explain the scope of the following branches of pathology: (C2) a) Histopathology b) Cytopathology c) Haematology	1
Cell injury & adaptation	**Cell adaptation** Define cell growth, differentiation and cell adaptation (C1) Describe the various cell adaptations with examples (C2) a) Hypertrophy b) Hyperplasia c) Atrophy d) Metaplasia e) Dysplasia **Necrosis** 1. Define necrosis(C1) 2. Describe the various types of necrosis with clinical examples (C2) a) Coagulative necrosis b) Colliquative necrosis/ Liquefactive necrosis c) Caseous necrosis d) Fibrinoid necrosis e) Fat necrosis f) Gangrene	2
Inflammation	Define inflammation. List the types with examples. (C1) Acute inflammation 1. Define acute inflammation. (C1) 2. Describe the causes and cardinal signs of acute inflammation. (C2) 3. Explain the vascular of acute inflammation. (C2)	3

Content	Competencies	Number of Hours
	4. Describe the cellular events in acute inflammation. (C2) 5. Explain the sequelae of acute inflammation(C2) 6. Explain the beneficial, harmful and systemic effects of acute inflammation. (C2) **Chronic inflammation** 1. Define chronic inflammation. (C1) 2. List the causes of chronic inflammation. (C1) 3. Describe the macroscopic and microscopic features in chronic inflammation. (C2) 4. List the cells in chronic inflammation. (C1) 5. Define granulomatous inflammation. (C2) 6. List the components of a granuloma and describe its morphology (C2) 7. List the causes of granulomatous inflammation. (C1)	
Healing & repair	**Wound healing** 1. Define granulation tissue and describe the formation of granulation tissue. (C2) 2. Describe the following: (C2) a. Healing by first intention. b. Healing by second intention. c. Wound organization, contraction and scarring. 3. Explain the factors which modify (influence) healing and repair. (C2)	1
Fluid & haemodynamic derangements	**Oedema** 1. Define oedema. (C1) 2. List the types of oedema. (C1) 3. Describe the pathogenesis and clinical features of oedema. (C2) **Shock** 1. Define shock. (C1) 2. List the various types of shock. (C1) 3. Describe the pathogenesis of septic and hypovolemic shock. (C2) **Thrombosis (Arterial & Venous)** 1. Define thrombosis. (C1) 2. Describe the factors influencing pathogenesis of thrombosis. (C2) 3. List causes of arterial and venous thrombosis. (C1) 4. List the fates of thrombus. (C1) **Embolism** 1. Define embolism. List the types of embolism with examples. (C1) 2. Describe the clinicopathologic consequences	4

Content	Competencies	Number of Hours
	of pulmonary thromboembolism (C2) **Infarction** 1. Define infarction. (C1) 2. Describe the types and clinical significance of infarction. (C2)	
Neoplasia	1. Define neoplasia (C1) 2. Describe the nomenclature of tumours with examples (C2) 3. Define dysplasia and anaplasia (C1) 4. Describe the differences between benign and malignant tumours (C2) 5. Define carcinogenesis. List the types of carcinogens with example of each (C1) 6. Define metastasis. (C1) 7. Describe the routes of metastasis with examples (C2) 8. Describe the prognostic factors of tumours with emphasis on staging & grading (C2) 9. Describe the various modalities for diagnosis of cancer (C2)	4
Infectious diseases	**Tuberculosis** 1. Describe the aetiology and mode of transmission of tuberculosis (C2) 2. Describe the clinical features of tuberculosis. (C2) 3. Describe the morphology of primary, secondary and miliary tuberculosis. (C2) **Leprosy** 1. List the aetiological factors of leprosy (C1) 2. Classify leprosy (C1) 3. Describe the morphology of lepromatous and tuberculoid leprosy (C2)	4
Genetics	1. Describe the basic concepts of genetics (C2) 2. Define with suitable examples (C1) a. Autosomal dominant b. Autosomal recessive c. X-linked recessive d. Chromosomal abnormalities 3. Define karyotyping (C1)	1
Unit 2: Haematology		
Diseases of RBCs	1. Define anaemia (C1) 2. Classify anaemia based on aetiology and morphology (C4) 3. Describe the clinical features, aetiology and basic investigation of (C2) a. Nutritional anaemias (B12/folate deficiency, iron deficiency)	3

Content	Competencies	Number of Hours
	b. Haemolytic anaemias (thalassemia, sickle cell anaemia)	
Bleeding disorders	1. List the types of bleeding disorders (C1) 2. Describe the clinical features and basic investigation of haemophilia (C2) 3. List the causes of thrombocytopenia (C1) 4. Describe the clinical features and basic investigation of immune thrombocytopenia (C2)	1
Diseases of WBC	1. Define leukemia (C1) 2. List the types of leukemia (C1) **Acute Leukaemia (AML, ALL)** 1. Describe the clinical features of AML & ALL. (C2) 2. Describe the laboratory diagnosis of AML and ALL (C2) **Chronic leukaemia (CML, CLL)** 1. Describe the clinical features, blood findings and chromosomal abnormality in CML (C2) 2. Describe the clinical features and laboratory diagnosis of CLL (C2)	2
Unit 3: Systemic Pathology		
Blood vessels & heart	**Hypertension** 1. Define hypertension (C1) 2. Classify hypertension (C4) 3. Describe the effects of hypertension on various organs (C2) **Atherosclerosis** 1. Define atherosclerosis (C1) 2. List the sites of involvement by atherosclerosis (C1) 3. Describe the predisposing factors, complications & clinical effects of atherosclerosis (C2) **Ischemic heart disease/Coronary artery disease** 1. Define ischemic heart disease (C1) 2. Describe the clinical spectrum of the disease (with reference to angina and myocardial infarction) (C2) **Aneurysm** 1. Define aneurysm (C1) 2. List the causes, types and complications of aneurysms (C1) **Rheumatic heart disease** 1. Define rheumatic heart disease (C1) 2. Describe its aetiology & clinical features (C2)	5

Content	Competencies	Number of Hours
	Cardiac failure 1. Define cardiac failure (C1) 2. List the causes of cardiac failure (C1) 3. Describe its pathophysiology & clinical features (C2)	
Respiratory system	**Pneumonia** 1. Define pneumonia (C1) 2. List the types of pneumonia(C1) 3. Describe the aetiology and clinical features of pneumonia (C2) **Chronic obstructive airway disease** 1. Define chronic obstructive airway disease. (C1) 2. List the types of chronic obstructive airway disease(C1) **Emphysema** 1. Define emphysema(C1) 2. List the types of emphysema (C1) 3. Describe the aetiology and clinical features of emphysema (C2) **Chronic bronchitis** 1. Define chronic bronchitis (C1) 2. Describe the aetiology and clinical features of chronic bronchitis (C2) **Bronchiectasis** 1. Define bronchiectasis (C1) 2. List the types of bronchiectasis. (C1) 3. Describe the aetiology and clinical features of bronchiectasis (C2) **Asthma** 1. Define asthma (C1) 2. List the types of asthma (C1) 3. Describe the aetiology and clinical features of asthma (C2) **Pneumoconiosis (Asbestosis, Silicosis, Coal worker's pneumoconiosis)** 1. Define pneumoconiosis (C1) 2. List the types of pneumoconiosis (C1) 3. Describe the aetiology and clinical features of pneumoconiosis (C2)	4
Gastrointestinal tract & liver	**Oral Cavity** 1. Enumerate the aetiological factors, clinical features and morphology of squamous cell carcinoma (C2) **Esophagus** 1. Describe the aetiology (risk factors) & clinical features of esophageal carcinoma (C2)	4

Content	Competencies	Number of Hours
	Gastritis 1. List the aetiological factors associated with gastritis (C1) 2. Describe the clinical features & complications associated with H.pylori associated gastritis.(C2) **Gastric & duodenal ulcers** 1. Definition gastric and duodenal ulcer (C1) 2. Describe the aetiology, gross pathology and clinical features of gastric and duodenal ulcer (C2) **GIT malignancies (Gastric & Colorectal)** 1. List the types of common GIT malignancies (C1) 2. Describe their predisposing factors & clinical features (C2) **Jaundice** 1. Define jaundice (C1) 2. List the types of jaundice with examples (C1) **Viral hepatitis** 1. Describe the aetiology of viral hepatitis (C2) 2. List the modes of infection (C1) 3. Describe the clinical features of viral hepatitis (C2) **Cirrhosis of liver** 1. Define cirrhosis (C1) 2. List the causes of cirrhosis (C1) **Liver failure** 1. Define liver failure (C1) 2. List the causes of liver failure (C1) 3. Describe its clinical features (C2)	
Renal system	Define nephrotic syndrome & nephritic syndrome with suitable examples (C1) **Renal failure** 1. Define renal failure (C1) 2. List its types & describe the clinical features (C2)	1
Endocrine system	1. Define hyperthyroidism & hypothyroidism (C1) 2. Describe the causes, clinical features and laboratory diagnosis of hyperthyroidism and hypothyroidism (C2) 3. Describe the causes & clinical features of multinodular goitre (C2) 4. Describe types, clinical features, complications & laboratory diagnosis of diabetes (C2)	2

Content	Competencies	Number of Hours
Nervous system	Define Cerebrovascular diseases (Stroke) (C1) Describe its causes and clinical features (C2)	1
Musculoskeletal system	**Fracture** 1. Define fracture (C1) 2. List the types of fracture (C1) 3. Describe the process of fracture healing (C2) 4. List the factors influencing fracture repair (C1) **Osteomyelitis** 1. Define osteomyelitis (C1) 2. Describe the aetiology and clinical features of osteomyelitis (C2) 3. Define and list the clinical features of Rheumatoid arthritis, osteoarthritis and osteoporosis (C1)	2

Learning Strategies, Contact Hours and Out of class engagement				
Learning Strategies	**Contact Hours**	**Out of class engagement**		
Lecture	45	45		
Assessment	-	-		
Total	**45**	**45**		
Assessment Methods:				
Formative:	**Summative:**			
Unit Test - Nil	1st Sessional Exam - SEQ (theory) 2nd sessional exam - SEQ (theory)			
Quiz - Nil	University exam – SEQ (theory)			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Sessional Examination 1	x	x		
Sessional Examination 2			x	x
End Semester/University Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Essential Pathology for Dental students, Harsh Mohan, 3rd edition, 2010 Jaypee. 2. General and systemic pathology, JCE Underwood and 5 th, S Cross, 7 edition, 2018, Churchill Livingstone.			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Ultrasound Physics and Doppler Principles**
Course Code	**CVT2301**
Academic Year	Second Year
Semester	III
Number of Credits	3
Course Prerequisite	Basic knowledge of cardiac anatomy, cardiac hemodynamics and basic physics
Course Synopsis	• Brief understanding of the technical aspect of an Ultrasound equipment and echocardiographic machine. • This course will make students to understand the cardiac hemodynamic assessment using Doppler principle and basic cardiac imaging using echocardiography.

Course Outcomes (COs):
At the end of the course, students shall be able to:

CO1	Define and explain the ultrasound use in obtaining echocardiographic images by understanding the ultrasound and tissue interactions, Classifying different ultrasound transducers and their instrumentation (C3)
CO2	Understand different modes of image acquisition and adjusting resolution with different factors that interfere with image quality(C3)
CO3	Understand the different Doppler modalities in physiologic assessment of cardiac function(C3)
CO4	Understand different echocardiographic planes/windows(C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x					x	x	
CO3	x					x	x	
CO4	x						x	

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1:		
History of echocardiography	• Recall the history of Development of various echocardiographic technologies(C1) • Understanding the Evolution of ultrasound	3

Content	Competencies	Number of Hours
	transducer (C2)	
Unit 2:		
Ultrasound physics and instrumentation	• Understanding the physical properties of ultrasound (C2) • Explaining the ultrasound tissue interaction(C2) • Defining specular reflection and specular scattering(C1)	6
Unit 3:		
The transducer	• Understanding the types of ultrasound transducers (C2) • Linear array and phased array(C2) • Explaining clinical application of transducer(C2) • Understanding the Near field and far field(C2) • Illustrating the instrumentation of 3D echo transducer and Transesophageal echo transducer (C2)	7
Unit 4		
Resolution	• Understanding different types of resolution- Spatial resolution, Contrast resolution, Temporal resolution (C2)	1
Unit 5		
Image creation and display option	• Explain the steps involved in image creation (C2) • Explain the different mode of image display- 2D, M mode (C2)	3
Unit 6		
Tissue Harmonic imaging	• Understanding the tissue harmonic imaging physics (C2) • Enumerating the uses and limitations(C2)	1
Unit 7		
2D cardiac chamber examination	• Understand the atrial, ventricular and valvular anatomy in parasternal windows (C1) • Understand the atrial, ventricular and valvular anatomy in apical windows (C2) • Understand the atrial, ventricular and valvular anatomy in subcostal window (C3) • Understand the atrial, ventricular and valvular anatomy in suprasternal windows (C3)	5
Unit 8		
Doppler	• Understanding the different Doppler formats:	6

Content	Competencies	Number of Hours
echocardiography Principles	Pulsed wave Doppler, continuous wave Doppler and color flow imaging (C2) • Define Aliasing(C1) • Explain Billiard Ball effect (C2) • Defining Doppler artefacts (C1)	
Unit 9		
Hemodynamic assessment by Doppler	Explaining the volume quantification methods: • Stroke volume calculation; Defining the formula, uses and limitations (C3) • Understanding the continuity equation; Defining the formula, uses and limitations (C3) • Understanding Bernoulli's equation Derivation of the formula, uses and limitations (C3) • Understanding Pressure half time(PHT) assessment ; Brief method, application of PHT in the assessment of valve area and aortic regurgitation (C4) • Illustrating the method of proximal iso velocity surface area(PISA), in evaluating regurgitant and stenotic valvular lesions Brief steps, Uses and limitations of PISA method (C4) • Evaluation of intracardiac pressure using doppler flow velocities. (C3)	10
Unit 10		
Tissue Doppler imaging (TDI)	• Defining the physical principles of TDI (C3) • Obtaining tissue annular velocity waveforms, Uses and limitations (C4)	3
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	
Lecture	40	-
Seminar	5	-
Total	**45**	**45**

Assessment Methods:				
Formative:		**Summative :**		
Assignments/Presentations		Mid Semester Exam		
		End Semester Exam		
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x		
Assignments/Presentations			x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Feigenbaum's Echocardiography, Book by Harvey Feigenbaum. 2. Textbook of clinical Echocardiography: Book by Catherine Otto, Latest Edition.
Additional References	The Echo Manual, Latest edition, Book by Jae K. Oh, James B Seward, A Jamil Tajik

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Stress Tests**
Course Code	**CVT2302**
Academic Year	Second
Semester	III
Number of Credits	3
Course Prerequisite	Basic Knowledge and understanding of cardiac hemodynamics and function.
Course Synopsis	This module provides an overview of the theoretical and practical application of stress testing in evaluating Cardiac function. This course includes exercise stress tests, pharmacological stress tests, and advanced imaging techniques. At the end of the course, students will understand the physiological principle underlying stress test, including the assessment of myocardial perfusion and function.

Course Outcomes (COs):
At the end of the course students shall be able to:

CO1	Describe the cardiovascular and pulmonary responses to exercise and outline the various types, indications, and contraindications for stress tests.(C2)
CO2	Understand the patient preparation, stress protocol, equipment identification, stress ECG interpretation, and stress test complications.(C3)
CO3	Understand stress test clinical responses, BP and HR responses during exercise, ECG findings, and illustrate the uses of exercise stress tests.(C3)
CO4	Explain pharmacological stress tests and advanced imaging techniques(C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x	x		x			x	
CO2	x		x	x	x		x	
CO3	x		x			x	x	
CO4	x		x			x	x	

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1:		
Introduction to exercise stress test	• Explain cardiovascular and pulmonary responses to exercise(C1) • List out types of exercise(C1)	10

Content	Competencies	Number of Hours
	• Define maximum oxygen uptake (C1) Define myocardial oxygen uptake(C1) Explain heart rate and BP response to exercise(C1) • Describe indications (coronary and noncoronary) and contraindications of Exercise stress test(C1)	
Unit 2:		
Exercise stress test techniques and procedure	• Describe patient preparation and procedure(C2) • Explain the stress protocol and test supervision(C2) • Name the equipment used for the stress test(C2) • Interpreting stress ECG(C2) • Explain complications of exercise stress test and four levels of angina scale for exercise tolerance test(C2)	5
Unit 3:		
Interpretation and uses of exercise stress test	• Describe clinical response, symptoms, subject appearance, and exercise capacity during the stress test(C3) • Explain BP and HR response during exercise(C3) • Interpret normal and abnormal ECG responses to exercise stress test(C3) • Illustrate uses of exercise stress test(C3) • Explain the uses of various drugs in exercise stress test like beta blockers, vasodilators, ACE inhibitors, calcium antagonists, digitalis, and other drugs(C4)	14
Unit 4:		
Dobutamine stress test	• List out indications and contraindications(C1) • Explain subject preparation, procedure, ECG recording, • Echo recording test supervision(C2) • Interpretation of ECG and Echo images in stress test(C4)	4
Unit 5:		
Atropine test	• List out indications and contraindications(C1) Explain uses and procedure(C4)	3

Content	Competencies	Number of Hours
Unit 6:		
Dipyridamole Test	• List out indications, contraindications, and uses(C1) • Describe the procedure and complications(C2)	3
Unit 7:		
SPECT and PET scan	• Explain various radiotracers, protocols, and technical artifacts (C2) • Interpret and analyse SPECT images(C4) • Explain perfusion and metabolic tracers(C4) • Interpretation and analysis of images(C4) • Describe MUGA scan(C4) • Describe CPET(C4)	6
	Total	45

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	30	
Seminar	5	
Assignment	5	
Revision	2	
Assessment	3	
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Assignment/Presentations	Mid Semester
	End Semester Examination

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid-Semester / Sessional Examination 1	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Braunwald's Heart Disease, 12th Edition - A Textbook of Cardiovascular Medicine 2. Brian P. Griffin (2018) Manual of Cardiovascular Medicine 5th edition.
Additional References	1. Hurst's the Heart, 14th Edition 2. Manual of Cardiovascular Medicine (SAE)by Sanjay Kumar Chugh

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Instrumentation**
Course Code	**CVT2303**
Academic Year	Second
Semester	III
Number of Credits	2
Course Prerequisite	Basic Knowledge about human anatomy and physiology and general physics
Course Synopsis	• This module helps in acquiring knowledge of the operational principles of diverse cardiac instruments. • Topics covered include cardiac pacing devices, transducers, electrodes, as well as the fundamentals of radiation and ultrasound. • Upon completion of the module, students will possess the competency to operate and analyze a range of cardiac instruments utilized in cardiac pacing, echocardiography and cardiac hemodynamic analysis.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Classify and explain the diverse types, operational mechanisms, and clinical applications of transducers and electrodes in medical practice. (C1)
CO2	Develop a thorough understanding of the fundamental principles, operational mechanisms, and clinical implications of Physiological Signals and Ultrasound.(C2)
CO3	Explore the fundamental concepts, classification, operational principles, and various modes of pacemakers.(C2) Acquire essential knowledge regarding the basics, classification, and operational principles of defibrillators and cardioverters.(C2)
CO4	Comprehend the operational principles of the Heart-Lung Machine, as well as those of X-ray, CT, and MRI technologies. (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes:

Content	Competencies	Number of Hours
Unit 1:		
Transducers	• Explain the classification and selection of transducer(C2) • Name and explain the different types of transducers(C2) • Explain the Pressure transducers(C2) • Explain the Photoelectric transducers (2)	4
Unit 2:		
Electrodes & Amplifiers	• Understand and Explain the working principles ofElectrodes (C2) • Name and Explain the types of electrodes(C2) • Understanding the Amplifiers for biomedical instrumentation(C2)	4
Unit 3:		
Physiological Signals& Measurements	• Remember and summarize the basics of ECG andPCG(C2) • Understanding the Instrumentation for measuringthe ECG & PCG signals (C2) • Build skills in measurement of Blood pressure (C3) • Build skills in the measurement of blood flow by using Electromagnetic & Doppler methods(C3)	4
Unit 4:		
Cardiac Pacemakers	• Name and explain the types of pacemakers (C2) • Understand External and Implantable pacemakers(C2) • Choose the appropriate mode of pacemaker andexplain the working application(C3) • Summarize the Pacemaker Electrodes (C2)	4
Unit 5:		
Defibrillators	• Name and Explain the types of Defibrillators (C2) • Compare the working principles of AC and DC defibrillators (C2) • Outline the types of electrodes and their features(C2) • Explain the working principle of cardioverters (C2)	3
Unit 6:		
Ultrasound	• Explain the working principle of Ultrasound (C2) • Understand and summarize the clinical applicationsof Ultrasound(C2)	3

Content	Competencies	Number of Hours
Unit 7:		
Heart-Lung Machine	• Understand the working principle of Heart-lung machine (C2)	3
Unit 8:		
Principles of radiation	• 1. Understand and summarize the working principle ofX-ray, CT & MRI (C2)	5
Total Hours		30

Learning Strategies, Contact Hours and Out of class engagement :					
Learning Strategies	**Contact Hours**	**Out of class engagement**			
Lecture	26	-			
Revision	2	-			
Assessment	2	-			
Total	**30**	**30**			
Assessment Methods:					
Formative:	**Summative:**				
Assignments/Presentations	Mid Semester Exam				
Mapping of Assessment with COs:					
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	
Mid-Semester Exam	x	x			
Assignments/Presentations			x	x	
Feedback Process:	End-Semester Feedback				
Main Reference:	1. John G Webster, “Medical Instrumentation Applications and Design”, John Wiley and Sons, New York, Edition 3, 2011 2. R S Khandpur, “Handbook of Biomedical Instrumentation”, McGraw Hill, Delhi, Edition 3, 2014				
Additional References	1. Ellenbogen KA, Karoly Kaszala. Cardiac pacing and ICDs. Hoboken, Nj: John Wiley & Sons; 2020. (7th edition). 2. Griffin BP. Manual of Cardiovascular Medicine. Lippincott Williams & Wilkins; 2018. (5th edition).				

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Clinics - III**
Course Code	**CVT2304**
Academic Year	Second
Semester	III
Number of Credits	3
Course Prerequisite	This course requires a basic understanding of cardiovascular physiology, anatomy, and medical terminology.
Course Synopsis	This course is designed to provide a foundational understanding of the technical and clinical aspects of treadmill stress tests and pharmacological stress tests. Students will gain insight into the diagnosis of coronary artery diseases and myocardial viability, as well as learn how to analyze, identify, and interpret various stress tests.

Course Outcomes (COs): At the end of the course student shall be able to:	
CO1	Develop a foundational understanding of both treadmill and pharmacological stress tests from technical and clinical perspectives. (C5, P3)
CO2	Produce insights into diagnosing coronary artery diseases and assessing myocardial viability. (C3. P3)
CO3	Analyze and identify various types of stress tests effectively. (C4, P4)
CO4	Develop skills needed to interpret stress test results accurately. (C5, P3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1		x	x	x				
CO2		x	x					
CO3		x	x			x	x	
CO4		x	x			x	x	

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1:		
Introduction to exercise stress test	• To build knowledge about BP and heart rate responses to exercise stress test(C3, P3)	10
Unit 2:		
Exercise stress test techniques and procedure	• Demonstrate patient preparation and procedure(C2, P2) • Build ability to use various stress protocol	12

Content	Competencies	Number of Hours
	• To demonstrate test procedure(C2, P2)	
	• To Name the equipment used in stress test(C1 ,P1) • Interpretation of stress ECG(C2, P2) • To understand the complications of exercise stress test(C2 ,P2)	12
Unit 3:		
Interpretation and uses of exercise stress test	• To identify and evaluate clinical responses, symptoms • and exercise capacity during stress test(C5, P4)	6
	• To analyse normal and abnormal ECG responses to exercise stress test(C4, P4)	10
	• To apply exercise stress test in various conditions(C3, P3)	10
	• Build knowledge about usage of various drugs in emergency conditions(C3, P3)	10
Unit 4		
Dobutamine stress test	• To build knowledge about indications and contraindications(C3, P3)	7
	• To Perform and analyse subject preparation, procedure, ECG recording, Echo recording test (C4, P4)	7
Unit 5		
Atropine test	• To build knowledge about indications and contraindications (C3, P3)	8
Unit 6		
Dipyridamole Test	• To know the indications, contraindications and uses(C1, P1)	6
	• Able to perform and analyse procedure and complications(C2, P2)	6
Unit 7		
SPECT scan	• To build knowledge about various radiotracers, protocols and technical artifacts (C3, P3)	8
	• To Interpret and analyse SPECT images(C4 , P4)	8
Unit 8		
PET scan	• To identify various perfusion and metabolic tracers(C3, P3)	8
	• To Interpret and analyse PET images(C4, P4)	7
	Total	**135**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of Class Engagement**
Self-directed learning (SDL)	22	-
Problem Based Learning (PBL)	16	-
Case Based Learning (CBL)	34	-
Clinic	63	-
Total	**135**	**135**

Assessment Methods:	
Formative:	**Summative:**
Clinical Record Book	-

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Clinical Record book	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Manual of Cardiovascular medicine by Griffin 2. The textbook of 'The heart' - by Hurst's 3. The Braunwald's textbook of Heart disease

SEMESTER - IV

Course code	:	Course title
PHC2403	:	Pharmacology
CPY2401	:	Clinical Psychology
BST3401	:	Biostatistics and Research Methodology
CVT2401	:	Basics of Cardiac Implantable Electronic Devices
CVT2402	:	Congenital Heart Disease - I
CVT2403	:	Clinics IV
CVT2404	:	Program Elective - I: Cardiac Interventional Hardwares
CVT2405	:	Program Elective - I : Analysis of Cardiac Implantable Electronic Devices

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Pharmacology**
Course Code	**PHC2403**
Academic Year	Second
Semester	IV
Number of Credits	03
Course Prerequisite	Nil
Course Synopsis	The course briefly addresses the classes of drugs acting on various systems of human body. This module will be delivered through lectures. Theory examination will be used to assess the students' transferable skills and learning outcomes. This module helps the students to understand the kinetics, dynamics and therapeutics of drugs that are relevant to allied health practice. Emphasis is laid on drugs that are commonly used by allied health practitioners. This module provides the background for decision making and treatment based on basic knowledge of drugs.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Explain mechanism of action, pharmacological actions, pharmacokinetic features, uses/ indications, rationale, adverse effects, contraindications and drug interactions of commonly used medications in the management of disorders of autonomic nervous system, central nervous system and gastrointestinal system (C2)
CO2	Explain mechanism of action, pharmacological actions, pharmacokinetic features, uses/ indications, rationale, adverse effects, contraindications and drug interactions of commonly used medications in the management of cancer, infections and disorders of respiratory system, blood, cardiovascular system and endocrine system (C2)
CO3	Apply fundamental pharmacology knowledge in management of health and diseases in allied health practice (C3)
CO4	Apply pharmacology knowledge in decision making of patient/client management. (C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x							
CO3	x							
CO4	x							

Course Content and Outcomes:

Content	Competencies	Number of Hours
Unit 1		
General Pharmacology	**A. Introduction :** 1. Define the following terms: pharmacology, pharmacokinetics, pharmacodynamics, pharmacotherapeutics, clinical pharmacology and toxicology (C1) 2. Define drug with examples. (C1) 3. Describe the following with examples: chemical name, non- proprietary/generic name and proprietary (brand) name of a drug. (C2) 4. List various sources of drug information. (C1) 5. List different sources of drugs with examples. (C1) 6. Explain different parts of a prescription. (C2) 7. Describe the various standard abbreviations used in prescription. (C1) **B. Routes of drug administration:** 1. Explain the advantages and disadvantages of the following routes of drug administration with examples of drugs administered by these routes: oral, sublingual, subcutaneous, intramuscular, intravenous, intradermal, topical, transdermal, inhalational and rectal. (C2) **C. Pharmacokinetics:** 1. Describe drug transport mechanisms. (C2) 2. Explain the factors affecting drug absorption. (C2) 3. Define bioavailability. (C1) 4. Explain first pass metabolism with examples of drugs having high first pass metabolism. (C2) 5. Define volume of distribution. (C1) 6. Explain the factors affecting volume of distribution. (C2) 7. Define biotransformation. (C1) 8. List the organs involved in biotransformation. (C1) 9. List the types of biotransformation reactions. (C1) 10. List different routes of drug excretion. (C1) 11. Define the following terms: plasma half-life, first order kinetics and zero order kinetics (C1) **D. Pharmacodynamics:** 1. Describe the different types of non-receptor mediated mechanisms of drug action with examples. (C2) 2. List different types of receptors with examples. (C1) 3. Define the following terms: affinity, intrinsic activity, efficacy, potency, agonist and antagonist. (C1) 4. Define the following terms with examples: competitive antagonist and non-competitive antagonist. (C1)	7

Content	Competencies	Number of Hours
	5. Explain synergism with an example. (C2) 6. Explain the following factors modifying drug action with examples:age, genetics, psychological states, pathological states, presence of other drugs and tolerance (C2) **E. Drug toxicity and safety:** 1. Define therapeutic index. (C1) 2. Define adverse drug reactions. (C1) 3. Describe the following terms with examples: predictable adverse drug reactions, unpredictable adverse drug reactions, side effects, toxic effects, idiosyncrasy,hypersensitivity, teratogenicity, iatrogenic disease, photosensitivity, dependence (C2)	
Unit 2		
Autonomic nervous system including skeletal muscle relaxants	**A. Cholinergic drugs:** 1. Name the parasympathetic neurotransmitter. (C1) 2. List the types of different cholinergic receptors. (C1) 3. Name the locations of different cholinergic receptors. (C1) 4. Describe the responses mediated through different cholinergic receptors at various sites. (C2) 5. Tell the classification of cholinergic drugs based on their mechanism of action. (C1) 6. Describe the mechanism of action of anticholinesterases. (C2) 7. List the therapeutic uses of anticholinesterases. (C1) **8.** List the adverse effects of anticholinesterases. (C1) **B. Anticholinergic drugs:** 1. Tell the classification of anticholinergic drugs based on their source. (C1) 2. Describe the pharmacological actions of atropine. (C2) 3. List the therapeutic uses of atropine and its substitutes. (C1) **4.** List the adverse effects of anticholinergic drugs. (C1) **C. Neuromuscular blocking drugs:** 1. Tell the classification of skeletal muscle relaxants based on their mechanism of action. (C1) 2. List the uses of the following: centrally acting skeletal muscle relaxants, peripherally acting skeletal muscle relaxants. (C1) 3. List the adverse effects of the following: centrally acting skeletal muscle relaxants, peripherally acting skeletal muscle relaxants. (C1)	7

Content	Competencies	Number of Hours
	D. Adrenergic drugs: 1. Name the sympathetic neurotransmitters. (C1) 2. List the types of different adrenergic receptors. (C1) 3. Name the locations of different adrenergic receptors. (C1) 4. Describe the responses mediated through different adrenergic receptors at various sites. (C2) 5. Describe the effects of adrenaline on: CVS, smooth muscle, eye, metabolism (C2) 6. List commonly used adrenergic drugs. (C1) **7.** List the common therapeutic uses of adrenergic drugs. (C1) **E. Adrenergic receptor antagonists:** 1. Tell the classification of adrenergic receptor antagonists based on their receptor selectivity. (C1) 2. Describe the pharmacological actions of propranolol on: CVS, respiratory system and eye. (C2) 3. List the important uses of α-blockers. (C1) 4. List the important uses of β-blockers. (C1) 5. List the adverse effects of β-blockers. (C1)	
Unit 3		
Central nervous system	**A. General anaesthetics (GAs) :** 1. Define general anaesthetics. (C1) 2. Tell the classification of general anaesthetics based on their route of administration. (C1) 3. List indications of general anaesthetics. (C1) 4. List the complications of general anaesthesia. (C1) 5. Describe preanaesthetic medication. (C1) 6. List the drugs used in preanaesthetic medication. (C1) **B. Local anaesthetics (LAs) :** 1. Define local anaesthetics. (C1) 2. Explain the mechanism of action of LAs. (C2) 3. List the LAs. (C1) 4. List the indications of LAs. (C1) **5.** List the different techniques of local anaesthetics. (C1) **C. Sedative & hypnotics** : 1. Define the following terms with examples: sedative and hypnotics. (C1) 2. List the benzodiazepines. (C1) 3. List the therapeutic uses of benzodiazepines. (C1) **4.** List the adverse effects of benzodiazepines. (C1) **D. Opioids:** 1. List the commonly used opioids. (C1) 2. Explain the pharmacological actions of morphine. (C2) 3. List the uses of morphine. (C1)	9

Content	Competencies	Number of Hours
	4. List the adverse effects of morphine. (C1) 5. List the contraindications of morphine. (C1) 6. Mention the antidote used for the opioid poisoning.(C1) **E. NSAIDs :** 1. Tell the classification of NSAIDs based on their selectivity to COX. (C1) 2. Explain the mechanism of action of NSAIDs. (C2) 3. Explain the pharmacological actions of aspirin. (C2) 4. List the uses of aspirin. (C1) 5. List the adverse effects of aspirin. (C1) 6. List the contraindications of aspirin. (C1) 7. Explain the advantages and disadvantages of selective COX-2 inhibitors over aspirin. (C2) 8. Explain the mechanism of action of paracetamol. (C2) 9. List the uses of paracetamol. (C1) 10. Mention the differences between aspirin and paracetamol. (C2) **F. Drug treatment of rheumatoid arthritis (RA):** 1. List NSAIDs, DMARDs and steroids used in the treatment of RA. (C1) 2. Explain the mechanism of action of methotrexate. (C2) 3. List the adverse effects of methotrexate. (C1) **G. Drug treatment of gout:** 1. List the drugs used for acute and chronic gout. (C1) 2. Explain the mechanism of action of the following: Allopurinol, probenecid, sulfinpyrazone (C2) 3. List the adverse effects of the following: Allopurinol, probenecid, sulfinpyrazone (C1) **H. Psychopharmacology :** 1. List the antipsychotics. (C1) 2. Explain the mechanism of action of chlorpromazine. (C2) 3. List the uses of chlorpromazine. (C1) 4. List the adverse effects of chlorpromazine. (C1) **I. Parkinsonism :** 1. List antiparkinsonian drugs. (C1) 2. List the adverse effects of levodopa. (C1) 3. Explain the pharmacological basis for combining levodopa with carbidopa. (C2) **J. Alcohol :** 1. Explain the management of methanol poisoning. (C2) **K. Antiepileptic drugs :** 1. List the drugs used in various types of seizures. (C1) List the adverse effects of phenytoin. (C1)	

Content	Competencies	Number of Hours
Unit 4		
GIT	**A. Drugs for peptic ulcer :** 1. Tell the classification of drugs used in peptic ulcer based on their mechanism of action. (C1) 2. Explain the mechanism of action of the following: proton pump inhibitors (PPIs), H_2 blockers, antacids and ulcer protectives. (C2) 3. List the therapeutic uses of the following: proton pump inhibitors (PPIs), H_2 blockers, antacids and ulcer protectives. (C1) 4. List the adverse effects of the following: proton pump inhibitors (PPIs), H_2 blockers, antacids and ulcer protectives. (C1) **B. Antiemetics:** 1. List various classes of antiemetics with examples. (C1) 2. List the therapeutic uses of the following: prokinetics, 5-HT_3 antagonists, anticholinergics and H_1 antihistaminics. (C1) 3. List the adverse effects of the following: prokinetics, 5- HT_3 antagonists, anticholinergics and H_1 antihistaminics. (C1) **C. Laxatives and antidiarrhoeals** : 1. List various classes of laxatives with examples. (C1) 2. List the therapeutic uses of laxatives. (C1) 3. List the composition of WHO-ORS. (C1) List the antimotility and antisecretory agents used in diarrhoea. (C1)	2
Unit 5		
Blood	**A. Haematinics :** 1. List oral and parenteral iron preparations. (C1) 2. List the therapeutic and prophylactic uses of oral and parenteral iron preparations. (C1) 3. List the adverse effects of oral and parenteral iron preparations. (C1) 4. List various preparations of vitamin B_{12} and folic acid. (C1) 5. Mention the therapeutic uses of the following: vitamin B_{12} and folic acid. (C1) **B. Anticoagulants :** 1. Tell the classification of anticoagulants based on their routes of administration. (C1) 2. Explain the mechanism of action of the following: heparin and warfarin. (C2) 3. List the therapeutic uses of the following: heparin and warfarin. (C1)	3

Content	Competencies	Number of Hours
	4. List the adverse effects of the following: heparin and warfarin. (C1) **C. Antiplatelet drugs :** 1. List antiplatelet drugs. (C1) 2. Explain the antiplatelet action of the aspirin. (C2) 3. List the therapeutic uses of antiplatelet drugs. (C1) **D. Fibrinolytics and antifibrinolytics**: 1. List fibrinolytics and antifibrinolytics. (C1) 2. List the therapeutic uses of fibrinolytics and antifibrinoytics. (C1)	
Unit 6		
Cardiovascular system	**A. Diuretics:** 1. Define the term diuretics. (C1) 2. Tell the classification of diuretics based on their mechanism of action. (C1) 3. Explain the mechanism of action of following: loop diuretics, thiazides, potassium sparing diuretics and carbonic anhydrase inhibitors. (C2) 4. List the important therapeutic uses and adverse effects of the following: loop diuretics, thiazides, osmotic diuretics and potassium sparing diuretics. (C1) **B. Drugs used in congestive heart failure (CHF):** 1. Tell the classification of drugs used in the treatment of congestive heart failure based on their mechanism of action. (C1) 2. Explain the mechanism of action of cardiac glycosides. (C2) **C. Antihypertensives:** 1. Tell the classification of antihypertensive agents based on mechanism of action (C1) 2. Explain the antihypertensive action of the following: ACEIs/ARBs, calcium channel blockers, thiazides, beta blockers (C2) 3. List the uses of the following: ACEIs and calcium channel blockers. (C1) 4. List the adverse effects of the following: ACEIs and calcium channel blockers. (C1) **D. Antianginal drugs**: 1. List the drugs used for acute attack and chronic prophylaxis of angina. (C1) 2. Explain the mechanism of action of nitrates. (C2) 3. List the therapeutic uses of nitrates (C1) 4. List the adverse effects of nitrates (C1) **E. Hypolipidemics:** 1. Tell the classification of hypolipidemics based on their mechanism of action. (C2) 2. Explain the mechanism of action of the	5

Content	Competencies	Number of Hours
	following: statins and fibrates. (C2) List the uses and adverse effects of the following: statins and fibrates. (C1)	
Unit 7		
Respiratory System	**A. Pharmacotherapy of bronchial asthma :** 1. Tell the classification of drugs used in the treatment of bronchial asthma based on their mechanism of action. (C1) 2. Explain the antiasthmatic action of the following: β_2- agonists, anticholinergics, mast cell stabilizers and inhaled glucocorticoids. (C2) 3. List the adverse effects of the following: β_2 agonists, anticholinergics, mast cell stabilizers and inhaled glucocorticoids. (C1) **B. Pharmacotherapy of cough :** 1. List drugs used in dry and productive cough. (C1) 2. Define the following terms with examples: mucolytics, expectorants, antitussives (C1) **C. Antihistaminics :** 1. List first generation and second generation antihistaminics. (C1) 2. List the uses of H_1 antihistaminics. (C1) 3. List the adverse effects of H_1 antihistaminics. (C1) 4. Describe the advantages of second generation antihistaminics over the first generation antihistaminics. (C2)	3
Unit 8		
Chemotherapy	**A. General aspects:** 1. Define the following terminologies with examples: antimicrobial agents (AMAs), antibiotic, bacteriostatic, bactericidal, chemoprophylaxis and suprainfection. (C1) List the problems that arise from using AMAs with examples. (C1) **B. Beta lactam antibiotics:** 1. List the groups of beta lactams with examples. (C1) 2. Explain the mechanism of action of beta lactam antibiotics. (C2) 3. Tell the classification of penicillins with examples .(C1) 4. List the uses of penicillins (C1) 5. List the adverse effects of penicillins (C1) **C. Cotrimoxazole:** 1. Explain the mechanism of action of cotrimoxazole (C2)	7

Content	Competencies	Number of Hours
	2. List the uses of cotrimoxazole (C1) 3. List the adverse effects of cotrimoxazole (C1) **D. Macrolides :** 1. List macrolides (C1) 2. List the uses of macrolides (C1) 3. List the adverse effects of macrolides (C1) **E. Fluoroquinolones:** 1. List commonly used fluoroquinolones (C1) 2. List the uses of fluoroquinolones (C1) 3. List the adverse effects of fluoroquinolones (C1) **F. Antifungal agents:** 1. List azole anifungals. (C1) 2. List the uses of azoles. (C1) 3. List the adverse effects of azoles. (C1) **G. Antiviral drugs :** 1. List classes of anti-retroviral drugs (anti-HIV) with examples. (C1) 2. List the commonly used antiviral drugs with examples. (C1) 3. Explain the mechanism of action of acyclovir. (C1) 4. List the uses of acyclovir. (C1) 5. List the adverse effects of acyclovir. (C1) **H. Antitubercular drugs :** 1. Tell the classification of antitubercular drugs with examples. (C1) 2. Explain the mechanism of action of the following: isoniazid, rifampicin, pyrazinamide, ethambutol (C2) 3. List the adverse effects of the following: isoniazid, rifampicin, pyrazinamide, ethambutol. (C1) 4. Explain the pharmacological basis for short course chemotherapy. (C2) 5. List the drugs used for short course chemotherapy of pulmonary TB. (C1) **I. Antileprotic drugs :** 1. List antileprotic drugs. (C1) 2. List the drugs used for multidrug therapy (MDT) for paucibacillary and multibacillary leprosy. (C1) **J. Aminoglycosides**: 1. List aminoglycosides. (C1) 2. Mention the common features of aminoglycosides. (C1) 3. List the uses of aminoglycosides. (C1) 4. List the adverse effects of aminoglycosides. (C1) **K. Antiamoebic drugs**: 1. List antiamoebic drugs. (C1) 2. List the uses of nitroimidazoles. (C1)	

Content	Competencies	Number of Hours
	3. List the adverse effects of nitroimidazoles. (C1) **L. Anthelmintics:** 1. List anthelmintic drugs. (C1) 2. List the uses of the following: albendazole, mebendazole and DEC. (C1) 3. List the adverse effects of the following: albendazole, mebendazole and DEC. (C1) **M. Anticancer drugs**: 1. Give examples for anticancer drugs. (C1) 2. List the general toxicities of anticancer agents. (C1) **N. Antimalarial drugs**: 1. List antimalarial drugs. (C1) 2. List the uses of chloroquine. (C1) List the adverse effects of chloroquine. (C1)	
Unit 9		
Hormones and related drugs	**A. Glucocorticoids**: 1. List glucocorticoids based on their duration of action. (C1) 2. Explain the anti-inflammatory and immunosuppressant actions of glucocorticoids. (C2) 3. List the therapeutic uses of glucocorticoids. (C1) 4. List the adverse effects of glucocorticoids. (C1) **B. Antidiabetic drugs:** 1. List insulin preparations based on their duration of action. (C1) 2. List the adverse effects of insulin. (C1) 3. Tell the classification of oral antidiabetic drugs based on their chemistry. (C1) 4. List the adverse effects of various classes of oral antidiabetic drugs. (C1) **C.Thyroid and anti-thyroid drugs:** 1. List the thyroid hormone preparations. (C1) 2. List the uses of thyroid hormone preparations. (C1) 3. List the antithyroid drugs acting at different steps of thyroid hormone synthesis. (C1) List the uses of antithyroid drugs. (C1)	2
	Total	**45**

Learning Strategies, Contact Hours and Out of Class Engagement				
Learning Strategies	**Contact Hours**		**Out of Class Engagement**	
Lecture	45		90	
Assessment	-		-	
Total	**45**		**90**	
Assessment Methods:				
Formative:	**Summative:**			
	Sessional I & Sessional II Exam (Theory)			
	End Semester Exam (Theory)			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Sessional Examination 1	x	x	-	-
Sessional Examination 2	-	-	x	x
End Semester Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Essentials of Medical Pharmacology, K.D. Tripathi, Jaypee brothers medical publishers (P) Ltd., 8th edition, 2018 2. Pharmacology for medical graduates, Tara Shanbag and Smita Shenoy, Elsevier Publications, 4th edition, 2019			
Additional References	1. Principles of Pharmacology: H L Sharma and K. K Sharma, Paras Medical Publishers, 3rd edition, 2017 2. Lippincott Illustrated Reviews: Pharmacology, Karen Whalen, Wolters Kluwer, 7th edition, 2018			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Clinical Psychology**
Course Code	**CPY2401**
Academic Year	Second
Semester	4
Number of Credits	3
Course Prerequisite	Nil
Course Synopsis	1. Orients and familiarises students with the basic psychological processes. 2. Enables the students to understand how psychological principles are applied daily. 3. Orients and familiarise them with various psychological disorders and psychological interventions.

Course Outcomes (COs): **At the end of the course, student shall be able to:**	
CO1	Explain the history, research methods, and scope of Psychology. (C2)
CO2	Explain the processes of perception, learning, memory, thinking, and intelligence (C2)
CO3	Outline the role of motivation, emotion, and personality in shaping human behavior (C2)
CO4	Outline the symptoms of mental disorders and psychological interventions for various mental health conditions. (C2)

Mapping of Course Outcomes (Cos) to Program Outcomes (POs):

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x					x		
CO2	x						x	
CO3	x						x	
CO4	x	x						

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1		
Introduction to Psychology	1. Define Psychology(C1) 2. Outline the evolution of Psychology as a scientific discipline (C2) 3. Enumerate the different branches of Psychology(C1) 4. Explain the importance of Experimental method in the field of Psychology(C2)	4

Content	Competencies	Number of Hours
	5. Explain the observation method in Psychology (C2)	
Unit 2		
Perception	1. Define Perception (C1) 2. Describe the various principles of Perceptual groupings (C2) 3. Illustrate the Gestalt laws of perception (C2) 4. Define Perceptual constancy and explain its types(C2) 5. What are Monocular and Binocular cues in Perception (C1) 7. Explain types of motion perception (C2)	4
Unit 3		
Learning	1. Define Learning (C1) 2. Explain Pavlov's Classical Conditioning(C2) 3. Explain the applications of Classical Conditioning(C2) 4. What is Operant Conditioning. (C1) 5. Define reinforcement and punishment (C1) 6. Compare the types of reinforcement and Punishment(C2) 7. Explain with examples the schedules of Reinforcement (C2) 8. Explain the applications of Operant Conditioning(C2) 9. Explain observation learning with its classic experiment (C2) 10. Explain the processes in observation learning (C2)	3
Unit 4		
Memory	1. Define Memory (C1) 2. Explain the processes that underlie memory (C2) 3. Define forgetting (C1) 4. Illustrate forgetting curve (C2) 5. Explain the various strategies to improve memory (C2)	2
Unit 5		
Thinking & Problem solving	1. Define thinking (C1) 2. What are the components of thinking (C1) 3. Define concepts(C1) 4. Compare the different types of concept (C2) 5. Define creative thinking and enumerate the steps in creative thinking (C1) 6. List the steps involved in problem solving (C1)	3

Content	Competencies	Number of Hours
	7. What are the different strategies used to solve problems (C1) (Trial & error, Heuristics, Algorithm)	
Unit 6		
Intelligence	1. Define Intelligence (C1) 2. Summarise the various theories of Intelligence (C2) (Two factor, Crystallised and Fluid, Multiple intelligence) 3. List the different types of Intelligence tests (C1) 4. Define Emotional Intelligence (C1) 5. What are the different components of emotional intelligence? (C1)	3
Unit 7		
Motivation & Conflict	1. Define Motivation (C1) 2. Explain the biological theories of Motivation (C2) (Drive reduction theory, Optimal arousal theory, Instinct theory) 3. Explain the Psychological theories of Motivation (C2) (Maslow's hierarchy theory) 4. Define Conflict (C1) 5. Explain the types of Conflict with examples (C2) (Approach- Approach conflict, Avoidance-Avoidance conflict, Approach- Avoidance conflict and Double Approach- Avoidance conflict)	3
Unit 8		
Emotion	1. Define Emotion (C1) 2. List the characteristics of Emotion (C1) 3. What are the functions of emotions (C1) 4. Explain the various theories of Emotion (C2) (James-Lange, Cannon- Bard, Schatcher-Singer)	3
Unit 9		
Personality	1. Define Personality(C1) 2. Explain the Psychodynamic theory of Personality (C2) 3. Explain the trait approach to Personality (C2) 4. Explain Rogers' humanistic approach in understanding Personality (C2) 5. Explain the various assessment methods in studying Personality (C2)	5
Unit 10		
Introduction to Clinical	1. Define clinical Psychology (C1) 2. Outline the scope of clinical psychology (C2)	4

Content	Competencies	Number of Hours
Psychology	3. Explain the concept of normality and abnormality (C2) 4. Summarize the various models of mental disorders (biological, psychodynamic, learning, cognitive, social cultural) (C2) 5. Enumerate the ethical principles in clinical psychology given by APA (C1)	
Unit 11		
Psychiatric disorders: an overview	1. Compare and contrast the DSM V and ICD 11 classificatory system (C2) 2. Outline various psychotic disorders (C2) (Schizophrenia and delusional disorders) 3. Summarise mood disorders (C2) (Depression, Mania and Bipolar disorders) 4. Summarise various substance use Disorder (C2) (Intoxication, Abuse, harmful use and Dependence) 5. Outline the various anxiety disorders (C2) (GAD, OCD, Phobias and Panic disorder) 6. Outline the various personality disorders based on ICD 11 (C2) 7. Outline the various childhood disorders (C2) (ADHD, CD, ODD, ID, Autism, SLD) (C2)	7
Unit 12		
Introduction to counselling and psychological interventions	1. Define counselling (C1) 2. Outline various types of counselling (C2) 3. Outline the characteristics of effective counsellors (C2) 4. Explain the theoretical framework of behaviour therapy (C2) 5. Explain the various behaviour therapy techniques (C2) (Shaping, chaining, time-out, token economy) 6. Outline various principles of supportive therapy (C2)	4

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	45	-
Revision	-	-
Assessment	-	-
Total	**45**	**45**

Assessment Methods:					
Formative:	**Summative:**				
Quiz	Mid Semester/Sessional Exam (Theory)				
	End semester exam (Theory)				
Mapping of Assessment with COs:					
Nature of Assessment		**CO1**	**CO2**	**CO3**	**CO4**
Quiz		x	x	x	x
Mid Semester/Sessional examination		x	x	-	-
End semester examination		x	x	x	x
Feedback Process:	**End-Semester Feedback**				
Main Reference:	1. Baron, R. A., Byrne, D., & Mankowitz, B. H. (1977). *Psychology: Understanding behaviour*. Philadelphia: W.B. Saunders Co. 2. Feldman, R. S. (1993). *Understanding psychology*. New York: McGraw-Hill. 3. Korchin, S.J. (2004). *Modern Clinical Psychology*. New Delhi: CBS Publishers & Distributors 4. Ahuja, N. (2011) *A Short Textbook Of Psychiatry*. New Delhi: Jaypee Brothers Medical Publishers				
Additional References	1. Myers, D. G. (2005). *Exploring psychology*. New York, NY: Worth Publishers.				

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Basics of Cardiac Implantable Electronic Devices**
Course Code	**CVT2401**
Academic Year	Second
Semester	IV
Number of Credits	3
Course Prerequisite	Basic knowledge about the cardiac conduction system and its abnormalities
Course Synopsis	This module provides a comprehensive overview of device-based therapies for treating conduction system disorders of the heart. Students will gain a thorough understanding of various implantable cardiac devices, including pacemakers, ICDs, and CRT devices. The course will cover the basic functions, programming features, and potential complications associated with these devices, equipping students with the knowledge necessary for their effective utilization in clinical practice.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Demonstrate comprehensive understanding of the fundamental concepts, components, and operation of cardiac implantable electronic device (CIED) systems. (C2)
CO2	Explain electrical concepts and applications of pacing systems, understand the power source of CIED systems, and summarize general indications and implantation procedures for both temporary and permanent pacemakers.(C2)
CO3	Understand the indications for permanent pacemaker and ICD implantation, outline lead design, and demonstrate CRT device implantation procedures.(C2)
CO4	Evaluate the role of ICDs and CRT in managing various cardiac conditions, and demonstrate proficiency in follow-up procedures for patients with CIEDs. (C4)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x					x	x	
CO2	x					x	x	
CO3	x			x	x		x	
CO4	x			x	x		x	

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Basic concepts of CIED system	• To classify the different CIED systems available for conduction system disorder (C2) • To understand the components of a CIED system (C2) • To understand the stimulation physics of CIED system (C2)	5
Pacing concept in CIED system	• To define the electrical concepts of pacing system (C1) • To summarize the applications of Ohms law in pacing system (C1) • To understand the power source of CIED system (C2)	5
Unit 2		
Temporary Pacemaker	• To list the components of a temporary pacing system (C1) • To outline the general indications for temporary pacemaker implantation (C2) • To summarize the implantation procedure (C2) • To construct skills in lead testing and troubleshooting (C2) • To understand the complications of temporary pacemaker (C2)	5
Permanent Pacemaker	• To list the Indication for Permanent pacemaker implantation (C1) • To illustrate the classification of NBG coding • To understand the lead design (C2) • To outline the implantation procedure (C2) • To build knowledge in programming parameters and lead testing (C2) • To explain timing cycle in permanent pacemaker (C2) • To summarize the effect of pacing on cardiac hemodynamics (C2) • To identify the procedural complications of permanent pacemaker implantation (C2) • To understand the common issues for the patient with permanent pacemaker (C2)	15
Unit 3		
Implantable Cardioverter Defibrillator	• To list the Indication for ICD implantation (C1) • To understand the components of ICD system (C2) • To indentify the lead design (C3)	5

Content	Competencies	Number of Hours
	• To build knowledge on ICD device implantation (C3) • To test lead and programming parameters of ICD device (C4) • To outline the arrhythmia detection in ICD (C2)	
Unit 4		
Cardiac Resynchronizat ion Therapy	• To outline the indications for CRT implantation (C2) • To understand the ventricular dyssynchrony and its types (C2) • To summarize the role of CRT (C2) • To build knowledge on CRT device implantation (C3) • To test lead and programming parameters of CRT device (C4)	5
Unit 5		
Follow up of the patient with CIED	• To understand the acute CIED implant follow up (C2) • To construct knowledge on long term CIED clinic follow up (C3) • To outline the frequency and mode of follow up (C2) • To summarize the special situations encountered by a CIED patient (C2)	5
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	27	-
Seminar	4	-
Self-directed learning (SDL)	8	-
Revision	4	-
Assessment	2	-
Total	**45**	**45**
Assessment Methods:		
Formative:	**Summative:**	
Unit test	Mid Semester Exam	
Assignments/Presentations	End semester Exam	

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Examination	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Ellenbogen KA, Karoly Kaszala. Cardiac pacing and ICDs. Hoboken, Nj: John Wiley & Sons; 2020. (7th edition). 2. Griffin BP. Manual of Cardiovascular Medicine. Lippincott Williams & Wilkins; 2018. (5th edition).
Additional References	1. Textbook of Cardiovascular Medicine: Braunwald's Heart Disease (11th Edition), 2021

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Biostatistics and Research Methodology**
Course Code	**BST3401**
Academic Year	Second
Semester	IV
Number of Credits	3
Course Prerequisite	Nil
Course Synopsis	1. To provide necessary foundation on • Introductory level biostatistics • Demography, vital statistics and epidemiology • Survey sampling methods • Fertility, morbidity, and mortality indices 2. To introduce the steps involved in research process

Course Outcomes (COs): At the end of the course student shall be able to:	
CO1	Summarize the variable types, scales of measurement and understand the role of biostatistics in health professions. (C2)
CO2	Apply appropriate descriptive statistics, visualizations, point, interval estimation, and Confidence Interval, parametric and non-parametric tests to variables in healthcare studies. (C3)
CO3	Outline the sources of demographic data and vital statistics, merits and demerits of Sampling distribution, probability and non-probability sampling techniques. (C2)
CO4	Explain the steps involved in a research process, epidemiology and observational study designs. (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x	x						
CO3	x	x						
CO4	x					x		

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Module 1: Introductory Biostatistics		
Introduction to Biostatistics	• Define statistics and biostatistics. (C1) • Describe the limitations and characteristics of biostatistics. (C2) • Explain the role of statistics in health sciences. (C2)	3

Content	Competencies	Number of Hours
Variables	• Summarize the types of variables with examples. (C2) Distinguish between qualitative & quantitative with appropriate examples. (C2) • Distinguish between continuous & discrete variables with appropriate examples. (C2)	
Scales of Measurement	• Describe nominal, ordinal, interval and ratio scale of measurement of variables with appropriate examples. (C2) • Distinguish between the four scales of measurement. (C2)	
Module 2: Descriptive Statistics		
Summarizing Data: Tabulation Methods	• **Illustrate** the qualitative, quantitative and chronological classification to tabulate and summarize data. (C3)	6 +1 SDL
Summarizing Data: Graphical Methods	• Describe graphical methods to summarize data: Pie chart, Bar chart, Line Plot, Histogram, Frequency Curve and Frequency Polygon. (C2)	
Measures of Central Tendency	• Explain the concepts of Mean, Median, Mode. (C2) • Explain the concepts of Quartiles and Percentiles.(C2)	
Measures of Dispersion	• Describe the concepts of Range, Inter-quartile range, Variance, Standard deviation and Coefficient of variation. (C2) • Explain the concept of skewness and describe three types of skewness. (C2) • Explain the concept of kurtosis and describe three types of kurtosis. (C2)	
Module 3: Introduction to Probability and Normal Distribution		
Probability: An Introduction	• Define the relative frequency approach to probability. (C1)	3
Normal Distribution	• Explain the characteristics of normal distribution. (C2) • Compute the area under the normal distribution curve. (C3)	
Module 4: Sampling Methods		
Need for Sampling	• Explain the need for sampling and the advantages of sampling over complete enumeration. (C2) • Explain sampling and non-sampling error. (C2)	3

Content	Competencies	Number of Hours
	• Define and distinguish probability and non-probability sampling methods. (C1)	
Random Sampling Methods	• Explain the uses and situation of each sampling technique and mention merits and demerits. (C2)	
Non-random Sampling Methods	• Explain the uses and situation of each sampling technique and mention merits and demerits. (C2)	
Module 5: Introduction to Correlation and Regression Analysis		
Correlation Analysis	• Define correlation and its properties. (C2) • Explain types of correlation with diagrams and appropriate examples. (C2) • Illustrate using scatter plot the different types of correlation.(C3) • Explain the Pearson's correlation coefficient and outline its properties. (C2) • Explain the Spearman's correlation coefficient and outline its properties. (C2)	4
Regression Analysis	• Distinguish between dependent and independent variables. (C2) • Explain the simple linear regression model along with the assumptions involved. (C2) • Identify the slope and intercept coefficient from the model. (C2) • Predict the dependent variable from the model for a given set of independent variables. (C3)	
Module 6: Testing of Significance		
Understanding population, sample, parameter and statistics, estimate and estimator	• Define and differentiate parameter and statistic with examples. (C2) • Define the basic terms-population, sample, sampling, parameter, statistic, estimate and estimator, point estimate. (C1) • Define and differentiate standard deviation and standard error. (C2)	6 +2 SDL
Sampling distribution/standard error	• Determine the sampling distribution/standard error of sample mean, sample proportion, difference between two means, difference between two proportions (Large sample approximation (CLT).(C3)	
Confidence Interval	• Construct and interpret confidence interval for mean, difference between two means,	

Content	Competencies	Number of Hours
	proportion, difference between two proportions (large sample approximation). (C3)	
Module 7: Testing of Hypothesis		
General procedure of testing of hypothesis	• Define/explain with example the concept of null hypothesis, alternative hypothesis, type I and type II errors. Define level of significance, power of the test and p-value, one sided and two-sided test. (C2)	6
Parametric test: Single mean test, difference between two means test, and paired t test.	• Explain the differences, merits and demerits of parametric and non-parametric over parametric tests. (C2)	
Non-Parametric test: Chi-square test, Mann-whiteney test, Sign test	• Give the situation for parametric and non-parametric tests. (C2)	
Module 8: Introduction to Research Methodology		
Research Methodology, Research Design and Review of Literature	• Explain the research process and describe various research designs with flowchart. (C2) • Explain different methods of data collection and data sources. (C2)	4 +2 SDL
Module 9: Vital Statistics and Epidemiology		
Introduction to demography, vital statistics and epidemiology	• Define Epidemiology, Demography and Vital statistics. (C1) • What are the sources of demographic data and vital statistics. (C1)	3 +2 SDL
Morbidity, mortality and fertility rates	• Define and distinguish rate, ratio and proportion (C1) • Explain prevalence and incidence. (C2) • Explain each measure of morbidity, mortality and fertility rates by stating the formula. (C2)	
Observational Study Design	• Explain the observational study designs (case report, case series, case-control, cross-sectional, ecological). (C2)	

Learning Strategies, Contact Hours and Out of Class Engagement		
Learning Strategies	**Contact Hours**	**Out of Class Engagement**
Lecture	38	38
SDL	7	22
Total	**45**	**60**

Assessment Methods:	
Formative:	**Summative:**
Unit Test	Mid Semester Exam
	End Semester Exam

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Examination	x	x	x	-
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Lwanga SK, Tye CY, Ayeni O. Teaching health statistics: lesson and seminar outlines. World Health Organization, Marketing and Dissemination, 1211 Geneva 27, Switzerland; 1999. 2. Health research methodology: a guide for training in research methods. World Health Organization; 2001. 3. Bonita R, Beaglehole R, Kjellström T. Basic epidemiology. World Health Organization; 2006. 4. Campbell MJ, Swinscow TD. Statistics at square one. John Wiley & Sons; 2011.
Additional References	1. Daniel, W. W., and Cross, C. L. (2018). Biostatistics: a foundation for analysis in the health sciences. Wiley. 2. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International. 3. Rosner, Bernard, (2010). Fundamentals of Biostatistics, 7th Edition, Duxbury Press. 4. Peter Armitage, Geoffrey Berry, J. N. S. Matthews, (2002). Statistical Methods in Medical Research, 4th Edition, Blackwell. 5. Wayne W. Daniel, (2004). Biostatistics_ A Foundation for Analysis in the Health Sciences, 8th Edition, Wiley Series in Probability and Statistics.

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Congenital Heart Disease - I**
Course Code	**CVT2402**
Academic Year	Second
Semester	IV
Number of Credits	4
Course Prerequisite	Knowledge of cardiac anatomy, embryology, and cardiac hemodynamics
Course Synopsis	The course covers the embryology, anatomy, classification, pathophysiology, clinical presentation, and diagnostic methods used in acyanotic congenital heart disease. In addition, this module provides insight into diagnostic methods used to detect these defects, such as chest X-rays, echocardiograms, and electrocardiograms. By the end of the course, students will have a comprehensive understanding of the diagnosis and management of acyanotic congenital heart disease.

Course Outcomes (COs):
At the end of the course, students shall be able to:

CO1	Understand the cardiac embryology,anatomic classification, pathophysiology, clinical presentation, diagnosis, and management of pre tricuspid, post tricuspid shunt lesions and anomalous pulmonary venous connection(C3)
CO2	Understand the embryology, anatomic classification, pathophysiology, clinical presentation, Diagnosis, and management of Left and right ventricular inflow and outflow anomalies(C3)
CO3	Understand the embryology, anatomic classification, pathophysiology, clinical presentation, Diagnosis, and management of Coarctation of aorta and patent ductus arteriosus(C3)
CO4	Understand the basic theory of chest X-ray and interpretation of various cardiac diseases by chest X-ray(C3)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x		x			x		
CO2	x				x	x		
CO3	x				x	x		
CO4	x			x		x		

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Cardiac malposition	• Understanding normal and abnormal visceral and cardiac situs (C3) • To know the association between cardiac malposition and possible congenital heart disease (C1)	3
Unit 2		
Atrial Septal defect (ASD)	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, ECG, X ray, echo and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 3		
Ventricular Septal Defect (VSD)	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 4		
Patent Ductus Arteriosus(PDA)	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, ECG, X ray, echo and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 5		
Total anomalous pulmonary venous connection (TAPVC)	• To know the prevalence and types(C1) • Explaining the embryology, classification (supra cardiac, intracardiac, infracardiac, mixed type; Obstrutive/non obstructive type) and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	5

Content	Competencies	Number of Hours
Unit 6		
Partial anomalous pulmonary venous connection (PAPVC)	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 7		
Ebsteins anomaly	• To know the prevalence and types(C1) • Explaining the embryology, classification, GOSE score and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 8		
Atrio-ventricular canal defect (AVCD)	• To know the prevalence and types(C1) • Explaining the embryology, classification (Partial, intermediate, transitional, complete AVCD) and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	5
Unit 9		
Aorto pulmonary Window (AP window)	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 10		
Co-arctation of Aorta(CoA)	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3)	4

Content	Competencies	Number of Hours
	• To understand the natural history, prognosis and management(C3)	
Unit 11		
Left ventricular inflow obstruction	• To know brief anatomy, embryology, classification, clinical presentation, diagnosis, and management of Cor triatriatum (C2) • To know brief anatomy, embryology, classification, clinical presentation, diagnosis, and management of Supra valvular mitral annular ring (C2) • To know brief anatomy, embryology, classification, clinical presentation, diagnosis, and management of the Parachute mitral valve (C2)	5
Unit 12		
Anomalous left coronary artery from pulmonary artery(ALCAPA)	• To know the prevalence(C1) • Explaining the embryology and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X-ray, echo findings, and cath findings(C3) • To understand the natural history, prognosis and management(C3)	3
Unit 13		
Congenital semilunar valve stenosis	• To understand prevalence, pathophysiology, classification, diagnosis and management of Congenital aortic stenosis(AS) -Supra valvular AS ,valvular AS , subvalvular AS (C3) • To understand the prevalence, pathophysiology, classification, diagnosis, and management of Congenital pulmonary stenosis(PS) -Supravalvular PS , Valvular PS -Subvalvular PS (C3)	5
Unit 14		
Chest X-ray	• Understanding the standard approach to chest x-ray Projection,Rotation,Exposure , and Inspiration film (C3) • To understand the pulmonary arterial flow and venous flow , Pulmonary plethora, Pulmonary Oligemia, Grades of pulmonary venous hypertension(C3) • Interpretation of Cardiac chamber enlargement: Right atrial enlargement, Left atrial enlargement, Right ventricular	6

Content	Competencies	Number of Hours
	enlargement,Left ventricular enlargement, (C3) • Interpretation of X-ray in congenital, valvular heart diseases and cardiomyopathies and pericardial effusion(C3)	
	Total	**60**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	50	-
Seminar/ Assignment	5	-
Revision	2	-
Assessment	3	-
Total	**60**	**60**

Assessment Methods:	
Formative:	**Summative:**
Assignment/presentation	Mid-semester exam
	End semester Exam

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Examination	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Park MK, Salamat M. Park's Pediatric Cardiology for Practitioners: South Asia Edition-E-Book. Elsevier Health Sciences; 2020 Aug 26. (8th edition) 2. Marelli A, Aboulhosn J. Perloff's Clinical Recognition of Congenital Heart Disease. Elsevier; 2022.(7th edition) 3. IB Vijayalakshmi, P Syamasundar Rao, Chugh R. A Comprehensive Approach to Congenital Heart Diseases. JP Medical Ltd; 2013.

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Clinics - IV**
Course Code	**CVT2403**
Academic Year	Second
Semester	IV
Number of Credits	2
Course Prerequisite	Basic knowledge in cardiac diagnostic tests
Course Synopsis	This course details essential topics in cardiac diagnostic tests such as performing and interpreting treadmill stress tests and assisting pharmacological stress tests. Upon completion, participants will have gained knowledge on ECG interpretation, Treadmill Testing (TMT), Ambulatory continuous ECG monitoring, basic echocardiographic views, pacemaker analysis, the use of cardiac hardware, its utility in various cardiac procedures, and the importance of aseptic techniques.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Acquire and interpret basic echocardiographic views independently (C1, P4)
CO2	Diagnose and grade structural and functional abnormalities using echocardiographic methods (C4, P5, P6)
CO3	Select and justify appropriate cardiac hardware for procedures C5, P4)
CO4	Compare normal and diseased cardiac structures and explain findings (C3, P4)

Mapping of Course Outcomes (COs) to Program Outcomes (POs)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1		x		x				
CO2		x				x		
CO3		x	x					
CO4		x	x					

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
ECG	• Should list the basic steps in the interpretation of any given ECG(P3) • Able to comment on the management strategy of abnormal ECGs(P4) • Should be aware of technical errors and apply technical skills to overcome them (P4)	10

Content	Competencies	Number of Hours
	• Able to correlate ECG with the clinical presentation (P4) • Should assess the severity of arrhythmias and timely management (P4)	
Unit 2		
TMT	• Should know the standard protocol of performing TMT and use of emergency drugs (P4) • To clinically correlate the patient's symptoms history with ECG (P4) • To analyze the test results and compare it with the baseline findings (P4) • To build knowledge in TMT interpretation and discuss the management (P4) • Should develop technical skills in patient rescue during an emergency (P4)	10
Unit 3		
Ambulatory ECG monitoring	• Should know to utilize different methods of lead placement in recording ECG (C2, P4) • Able to analyze and interpret stored ECG data (P4, C2) • To build knowledge in identifying serious arrhythmias and look for treatment options (P4, C3)	5
Unit 4		
Basics of Echocardiography	• To apply the learned principles of echocardiography during clinical practice (C3, P4) • To build knowledge about ethics and minimize ethical issues (C1, P2) • Should be able to perform routine echocardiography independently (C3, P4) • Should choose appropriate 2D echo views to visualize LV segments and identify wall motion abnormality (P4, C3) • Should interpret the Doppler studies with newer methods (C3 , P4)	30
Unit 5		
Pacemaker analysis	• Should classify the type of pacemaker based on the ECG recording (P2, C2) • Able to assess the parameters and their importance during analysis (P4, C2) • To perform pacemaker analysis individually based on the mode implanted (P4, C3) • To add findings based on analysis, history,	10

Content	Competencies	Number of Hours
	and a frame for a new diagnosis (P4, C3) • To diagnose pacemaker-related problems and find an appropriate solution (P4, C3)	
Unit 6		
Basic catheterization	• To apply basic principles of X-ray during catheterization procedures (C1, P1)	25
	Total	**90**

Learning Strategies, Contact Hours, and Out of class engagement				
Learning Strategies	**Contact Hours**	**Out of class engagement**		
Self-directed learning (SDL)	10	-		
Problem-Based Learning (PBL)	10	-		
Case Based Learning (CBL)	10	-		
Clinic	60	-		
Total	**90**	**90**		
Assessment Methods:				
Formative:	**Summative:**			
Clinical Record Book				
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Clinical Record Book	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. An Introduction to Electrocardiography 8th Edition by Leo Schamroth 2. Moss & Adams' Heart Disease in Infants, Children, and Adolescents: Including the Fetus and Young Adult 3. Grossman's Cardiac Catheterization, Angiography, and Intervention by William Grossman.			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Interventional Hardwares**
Course Code	**CVT2404**
Academic Year	Second
Semester	IV
Number of Credits	3
Course Prerequisite	Basic knowledge of cardiac anatomy and physiology
Course Synopsis	This module helps to obtain basic knowledge about various cardiac interventional hardware design and their importance in various cardiac procedures. Students will understand their utilization and associated benefits and complications which emphasizes a safe interventional practice.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Summarize cardiac catheterization evolution, list cath lab procedures and equipment, and identify vascular access complications (C2)
CO2	Understand X-ray theory, imaging modes, Seldinger technique, and design of cardiac hardware (C2)
CO3	Explain manifold and pressure transducer systems, classify guide wires, and summarize balloon catheter and stent properties (C2)
CO4	Summarize radiation effects and safety measures, outline access routes, and explain balloon catheter usage (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x		x					
CO3			x	x				
CO4	x							

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
Introduction to Cardiac Cath	• To summarize the evolution of Cardiac catheterization (C2) • To list the procedures performed in the cathlab system (C1) • To identify the equipment in catheterization laboratory (C3)	3

Content	Competencies	Number of Hours
Cine angiographic system in Cathlab	• To summarize the basic X-ray theory (C2) • To distinguish the Imaging modes in Cardiac cine angiography system (C4) • To understand the biological effects of radiation exposure (C2) • To list the radiation safety measures inside a cathlab system (C1) • To understand the various application in a cine-angiographic system during procedure (C2)	4
Unit 2		
Vascular access routes	• To explain the Seldinger technique (C2) • To outline the various arterial access used to perform catheterization (C2) • To outline the various venous access used to perform catheterization (C2) • To list the complications associated with vascular access (C1)	5
Unit 3		
Introduction to diagnostic hardwares	• To understand Seldinger Needle used in Vascular access (C2) • To summarize the Introducer set (C2) • To identify the manifold system (C3) • To build knowledge on pressure transducer system (C3)	3
Cardiac Catheters	• To summarize the Introduction to cardiac catheters (C2) • To outline the classification of cardiac catheters (C2) • To understand the design of cardiac catheters (C2) • To list the properties of catheters (C1) • To define the sizing of the catheters (C1)	5
Catheters in Right heart and Left heart catheterization	• To understand the properties and usage of various Right Heart catheters (C2) • To understand the properties and usage of various Left Heart catheters (C2) • To develop knowledge on the properties and usage of various Coronary catheters (C3)	4
Balloon Floatation catheters	• To understand the design & properties of various balloon catheters (C2) • To explain the usage of balloon catheters in different conditions (C2)	4
Unit 4		
Guide Wires	• To illustrate the types of guide wires used in catheterization (C2)	5

Content	Competencies	Number of Hours
	• To understand the design and properties of coronary guide wire (C2) • To list the classification of guide wires (C1)	
Unit 5		
Coronary Balloon Catheter	• To explain the design and properties of coronary balloon catheter (C2) • To understand the classification and various types coronary balloon catheters (C2) • To construct the knowledge on use of Indeflator device (C3)	5
Unit 6		
Stents	• To outline the importance of stent usage (C2) • To summarize the design of stents (C2) • To understand the construction and manufacturing of the stents (C2) • To develop knowledge on the balloon expandable and self-expandable stent designs (C3) • To list the properties of stents (C1) • To summarize the endovascular stent graft design and properties (C2)	7
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement :				
Learning Strategies	**Contact Hours**	**Out of class engagement**		
Lecture	30	-		
Seminar	10	-		
Revision	3	-		
Assessment	2	-		
Total	**45**	**45**		
Assessment Methods:				
Formative:	**Summative:**			
Unit test	Mid Semester Exam			
Assignments/Presentations	End semester Exam			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Moscucci M. Grossman & Baim's Cardiac Catheterization, Angiography, And Intervention. New			

	York: Wolters Kluwer Medical; 2020. (9th Edition) 2. Kern MJ, Lim MJ, Sorajja P. The Interventional Cardiac Catheterization Handbook. Philadelphia: Elsevier Health Sciences; 2017 (7th Edition).
Additional References	1. Textbook of cardiovascular medicine: A textbook of Braunwald's Heart Disease, 2021 (11th Edition)

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Analysis of Cardiac Implantable Electronic Devices**
Course Code	**CVT2405**
Academic Year	Second
Semester	IV
Number of Credits	3
Course Prerequisite	Basic understanding of advanced cardiac sciences and the fundamentals of the ECG.
Course Synopsis	This module covers temporary and permanent cardiac pacemakers. Students will learn indications, procedural techniques, and hardware used in pacemaker implantation. Advanced pacing modes like rate-adaptive pacing and sensor technologies are explored. The module bridges the gap between technical knowledge and clinical application of pacemakers, enabling skills in data interpretation, device analysis, and patient follow-up management.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Describe the purposes, devices, and lead configurations used in temporary pacemakers. (C2)
CO2	To outline the diverse methodologies in various pacing terminology and procedural specifics. (C2)
CO3	Assessing and identifying pacemaker complications during and after implantation, emphasizing the importance of initial settings, monitoring post-procedural hemodynamics, and follow-ups. Additionally, determining patient selection, preparation, and the procedure for permanent pacemaker implants. (C4)
CO4	To evaluate the selection, preparation, and implementation of permanent pacemaker implantation for patients. (C5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x	x						
CO2		x						
CO3	x	x	x	x				
CO4	x	x	x					

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Basics of cardiac pacing: components of pacing, defibrillation, and resynchronization therapy systems	• Explain the basic hemodynamics of cardiac pacing(C2) • Explain Stimulation physics. (C2) • List the types of cardiac implantable electronic devices (C5)	4
Unit 2		
Indications of temporary pacemaker	• To enumerate indications in acute myocardial infarction(C2) • To understand Temporary pacing for procedural interventions(C2) • To identify Drug induced bradycardia(C3) • To identify other indications for temporary pacing(C3) • To examine Temporary pacing for tachycardia • Explain Preliminary setting in Cath lab(C2) • To identify complications(C3) • Describe Post procedural setting in ICU as per hemodynamic requirement(C2)	10
Unit 3		
Permanent pacemaker	• To identify indications for permanent pacemaker in conditions like Sinus node dysfunction, Acquired atrioventricular block, Reflex syncope, orthostatic hypotension, genetic cardiomyopathy, systolic heart failure and various other conditions (C3)	2
Pacemaker Hardware	• To understand lead designs, materials and functional characteristics(C2) • Identify Pacemaker monitoring, detecting and reporting of lead malfunction (C3) • To understand parts and circuits in pulse generator(C2)	4
Rate adaptive pacing and other sensors	• To explain types of sensors(C2) • To choose right sensor(C1) • To understand programming of pacemaker sensor(C2)	3
Unit 4		
Hemodynamics	• To determine hemodynamics of cardiac pacing and pacing mode selection(C5)	2

Content	Competencies	Number of Hours
Unit 5		
Techniques of pacemaker implantation Lead extraction	• Selection of patient and preparation(C1) • To choose Various Access(C3) • Importance of pacemaker pocket and lead implantation(C5) • Explain Generator insertion(C2) • To analyze Post procedural management and complications(C4) • To understand automatic mode switching • To understand common pacemaker problems (C2) • Determine Techniques and tools used for extraction(C5)	9
Unit 6		
Pacemaker timing cycles and special features	• Defining Pacing nomenclature(C1) • Choosing Pacing modes(C3) • Explain Timing cycles(C2)	5
Unit 7		
Evaluation, troubleshooting and management of pacing system	• Approach to evaluate pacemaker(C4) • Explain Differential diagnosis of device malfunction(C2) • Examine abnormalities In the mechanical components of a pacing system(C4) • Analyze Electrocardiographic manifestations of pacer malfunction(C4) • To inspect Problems with sensing(C4) • To test for Pacing at an unexpected rate or sudden change in pacing rate(C4) • Analysis of stored device data(C4)	6
	Total	**45**

Learning Strategies, Contact Hours, Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	40	-
Seminar /Assignment	5	-
Total	**45**	**45**
Assessment Methods:		
Formative:	**Summative:**	
Unit Test	Mid Semester Exam	
Assignments/Presentations	End semester Exam	

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Ellenbogen KA, Karoly Kaszala. Cardiac pacing and ICDs. Hoboken, Nj: John Wiley & Sons; 2020. (7th edition). 2. Griffin BP. Manual of Cardiovascular Medicine. Lippincott Williams & Wilkins; 2018. (5th edition).			

SEMESTER- V

COURSE CODE		COURSE TITLE
CVT3301	:	Basics in Cardiac Cath and Hardwares
CVT3302	:	Miscellaneous Cardiovascular Diseases
CVT3303	:	Congenital Heart Disease - II
CVT3304	:	Valvular Heart Disease
CVT3305	:	Clinics - V
*** ****	:	Open Elective - II

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Basics in Cardiac Cath and Hardwares**
Course Code	**CVT3301**
Academic Year	Third
Semester	V
Number of Credits	4
Course Prerequisite	Fundamental understanding of Cardiac Catheterization Laboratory
Course Synopsis	This module aims to provide students with a comprehensive understanding of X-ray physics and radiation, including their potential adverse effects. Additionally, it encompasses an overview of diagnostic and therapeutic procedures conducted in the Cardiac Catheterization Laboratory. By the conclusion of the module, students will have acquired the necessary knowledge and skills to support diagnostic procedures and device closure interventions. Furthermore, they will possess fundamental insights into the hemodynamic assessment of cardiac diseases through invasive testing methods in addition to essential knowledge of cardiac pharmacology.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Recall the fundamental principles involved in X-ray production, detection, and image processing techniques utilized within a Cardiac Catheterization Laboratory.(C1)
CO2	Recall and comprehend aseptic procedures necessary for upholding sterility in a Cardiac Catheterization Laboratory setting and Implement appropriate vascular access techniques for patients undergoing interventional procedures in the Cath Lab, ensuring the safety and efficacy of catheterization.(C3)
CO3	Acquire knowledge in effectively assessing invasive hemodynamic data to comprehend diverse cardiac disease conditions. (C2)
CO4	Understanding the role of contrast and cardiac pharmacological agents, evaluating their effects on cardiovascular diseases. (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x	x		x			x	
CO2	x	x	x	x	x			
CO3	x	x				x		
CO4	x					x		

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
X-ray theory and physics	• To outline the image formation (C2) • To illustrate the cinefluorographic system (C3) • To classify the various Imaging modes (C4) • To develop knowledge on image detection and processing (C4)	4
Unit 2		
Radiation Physics and effects	• To classify the Biological effects of radiation (C2) • To explain the radiation exposure dose(C2)To construct strategies to limit radiation exposure(C3) • To list the radiation safety measures (C4)	4
Unit 3		
Medical asepsis	• To name the Corner stones of Medical asepsis (C1) • To understand the principles (C2) • To explain the elements and surgical aspects(C2) • To remember the standard precautions (C2)	4
Unit 4		
Vascular access	• Relate and explain the umbilical approach (C3) • Relate and explain the femoral approach (C3) • Relate and explain the Subclavian approach (C3) • Relate and explain the Radial approach (C3) • Relate and explain the Internal jugular approach (C3)	4
Unit 5		
Catheterization Hardware's	• Identify and demonstrate the Diagnostic hardware's – introducer set, catheters, wires, and other accessories (C4) • Identify and demonstrate the interventional hardware's guiding catheters, guide wires, balloons, stent system, bare metal stent, drug eluting stent and covered stents (C4)	6
Unit 6		
Introduction to cardiacCath procedures	• 1.To explain the guidelines for diagnostic Cath (C3)2. To illustrate the premedication, anesthesia and sedation (C2) • To Apply the skills in understanding the equipment and technique (C4) • Identify the selection of catheters(C3) • Examine the standard angiographic views (C4) • Applying the knowledge in interpretation of angiograms (C3)	8

Content	Competencies	Number of Hours
Unit 7		
Closure Devices and coils	• Identify and demonstrate the Devices for ASD, VSD, PDA, PFO, LAA,RSOV (C4)	4
Unit 8		
Right heart and leftheart study	• Apply knowledge in catheters selection (C4) • To define the indications, contra-indications and common uses (C3) • To illustrate the technique (C4) • Develop knowledge in pressure tracing and waveforms with normal values (C4) • Interpretation and identification of pressure tracings in various diseased conditions(C5) • Interpretation of pitfalls and to take corrective actions (C5)	6
Unit 9		
Measurement of hemodynamic variables	• Functioning of Pressure measurements and its equipment (C4) • Explain the cardiac output measurements by various techniques (C3) • To calculate the vascular resistancemeasurements (C4) • To assess the shunt detection and quantification (C4) • calculation of stenotic valve orifice area (C4) • To analyze the pitfalls in hemodynamic variables (C5) • To take corrective measures in pressure measurement (C5)	8
Unit 10		
Contrast media andradiation dose	• To understand the pharmacology of contrastagents (C3) • Classifications of contrast agents(C2) • To illustrate the indication and uses of contrast agents (C3) • Outline the anphylatoc reactions of contrast agents (C3) • To remember the contrast dose for various procedures (C2) • Identification of contrast-related complications (C4) 7.Explain contrast-induced nephropathy (C4)	4
Unit 11		
Cardiac pharmacology	• To define and explain the various cardiac drugs in terms of mechanism and uses (C2) -beta blockers	8

Content	Competencies	Number of Hours
	-calcium channel blockers -bronchodilators -diuretics -narcotics -thrombolytic -nitrates -vasodilators -antiplatelet -steroids	

Learning Strategies, Contact Hours and Out of class engagement					
Learning Strategies	**Contact Hours**	**Out of class engagement**			
Lecture	45	-			
Seminar/ Assignment	10	-			
Revision	3	-			
Assessment	2	-			
Total	**60**	**60**			
Assessment Methods:					
Formative:		**Summative:**			
Unit Test		Mid Semester Exam			
Assignments/Presentations		End Semester Exam			
Mapping of Assessment with COs:					
Nature of Assessment		**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam		x	x	-	-
Assignment/Presentations		-	-	x	x
End Semester Exam		x	x	x	x
Feedback Process:	End-Semester Feedback				
Main Reference	• Textbook of Interventional Cardiology – By Grossman • Manual of cardiovascular medicine – By Griffin				
Additional References	• Handbook of Interventional Cardiology – Morten J kern				

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Miscellaneous Cardiovascular Diseases**
Course Code	**CVT3302**
Academic Year	Third
Semester	V
Number of Credits	3
Course Prerequisite	Foundational understanding of general medicine and cardiology, with an emphasis on basic cardiovascular physiology and anatomy
Course Synopsis	This course on miscellaneous cardiovascular diseases covers various conditions like hypertension, endocrine and connective tissue disorders, hematology, infectious diseases, and vascular conditions. It explores pathophysiology, diagnosis, and management, including the latest advancements and lifestyle impacts, aiming to equip participants with comprehensive knowledge and skills for optimal patient care.

Course Outcomes (COs): At the end of the course student shall be able to:	
CO1	Identify the pathophysiology of various cardiovascular diseases including hypertension, endocrine and connective tissue disorders, hematology, infectious diseases, and vascular conditions. (C1)
CO2	Discover knowledge on the diagnosis process for miscellaneous cardiovascular diseases, incorporating the latest advancements in medical science. (C3)
CO3	Construct management strategies for diverse cardiovascular conditions, focusing on both traditional treatments and the impact of lifestyle changes. (C3)
CO4	Develop comprehensive skills for delivering optimal patient care in the field of cardiovascular diseases, aimed at improving patient outcomes (C5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x						x	
CO3	x		x				x	
CO4	x					x	x	

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Systemic Hypertension	• Able to list the causes, define systemic hypertension and hypertensive crisis (C1) • Able to explain the pathophysiology (C2) and categorize the types of systemic hypertension (C4) • To identify and differentiate systemic hypertension from other conditions based on the clinical presentation (C3) • To illustrate structural and functional changes of heart secondary to systemic hypertension by 2D echocardiographic technique (C2) • To develop knowledge in identifying the treatment of choice considering patients benefits (C3)	4
Pulmonary Hypertension	• Able to list the causes and provide definition on PHTN (C1) • Able to explain the pathophysiology of the disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To classify pulmonary hypertension on basis of primary or secondary lesions (C4) • To explain cardiac function secondary to pulmonary hypertension by ECG and 2D echocardiographic techniques (C5) • To develop knowledge in early diagnosis of disease by providing information on management (C3)	4
Unit 2		
Endocrine / metabolic diseases Diabetes mellitus	• Able to list the causes, define Diabetes mellitus (C1) • To identify and differentiate forms of diabetes based on the clinical presentation, other determinants and grade its severity based on the criteria (C4) • To explain structural and functional changes of heart secondary to diabetes mellitus by 2D echocardiographic technique (C5) • To develop knowledge in identifying the treatment of choice considering patients benefits (C3)	2

Content	Competencies	Number of Hours
Carcinoid heart disease	• Able to list the causes, define Carcinoid disease (C1) • To clinically differentiate other pathological states having similar clinical presentation (C3) • To explain structural and functional changes of heart secondary to carcinoid disease by 2D echocardiographic technique (C5) • To develop knowledge in providing a precise diagnosis for better prognosis (C3)	2
Hypo/ Hyperthyroidism	• Able to list the causes, define Hypo/ Hyperthyroidism (C1) • Able to understand and explain the pathophysiology of the disease (C2) • To clinically differentiate other pathological states having similar clinical presentation (C3) • To classify the severity based on lab investigations (C4) • To explain the cardiac function secondary to abnormal thyroid levels by basic and advanced 2D echocardiographic techniques by (C5) • To develop knowledge in early diagnosis by providing information on management (C3)	2
Unit 3		
Connective tissue / Auto immune disorders	• Should list the causes, define SLE, Scleroderma and Marfan syndrome (C1) • Able to understand and explain the pathophysiology of these disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation (C3) • To explain cardiac function by basic and advanced 2D echocardiographic techniques based on diagnostic criteria (C5) • To develop knowledge in early diagnosis by providing information on management (C3)	4
Unit		
Restrictive Cardiomyopathy: Infiltrative	• Able to list the causes, provide definition and explain the pathophysiology on sarcoidosis and amyloidosis (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To explain cardiac function secondary to sarcoidosis and amyloidosis by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of	4

Content	Competencies	Number of Hours
	disease by providing precise information on management (C3)	
Storage	• Able to list the causes and provide definition and explain the pathophysiology on Hemochromatosis, Fabry's, Pompe's, Gaucher disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To explain cardiac function secondary to Hemochromatosis, Fabry's, Pompe's, Gaucher disease by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on management (C3)	4
Endomyocardial	• Able to list the causes and provide definition and explain the pathophysiology on Carcinoid heart disease, Endomyocardial Fibrosis and Hypereosinophilic syndrome (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To explain cardiac function secondary to Carcinoid heart disease, Endomyocardial Fibrosis and Hypereosinophilic syndrome by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on management (C5)	3
Non-infiltration	• Able to list the causes and provide definition and explain the pathophysiology on Idiopathic and diabetic cardiomyopathy (C1) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To explain cardiac function secondary to Idiopathic and diabetic cardiomyopathy by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on management (C5)	2
Unit 5		
Haematological condition:	• Able to list the causes, definition and provide classification of sickle cell anemia(C1)	2

Content	Competencies	Number of Hours
Sickle cell anemia	• Able to understand and explain the pathophysiology of the disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To explain cardiac function impairment secondary to sickle cell anemia by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on management (C3)	
Unit 6:		
Infectious diseases : Human immune deficiency virus	• Able to list the causes and provide definition on HIV (C1) • Able to understand and explain the pathophysiology of the disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • To explain the cardiac function impairment secondary to HIV by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on palliative management (C3)	2
Unit 7:		
Vascular conditions: Takayasu arteritis	• Able to list the causes and provide definition on the Takayasu arteritis (C1) • Able to understand and explain the pathophysiology of the disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • Should be able to provide classification of Takayasu arteritis based on vessel involvement (C4) • Explain the structural and functional changes secondary to arteritis by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on palliative management (C3)	2
Diseases of Aorta	• List the classification of aortic aneurysm and aortic dissection • Explain the etiopathogenesis of these disease	4

Content	Competencies	Number of Hours
	• Explain the structural and functional changes secondary to these diseases by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on palliative management and risk stratify them(C3)	
Kawasaki disease	• Able to list the causes and provide definition on the Kawasaki disease (C1) • Able to understand and explain the pathophysiology of the disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • Explain the structural and functional changes secondary to kawasaki by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on palliative management and risk stratify them(C3)	2
Unit 8		
Cardiac trauma	• Able to list the causes and provide definition on cardiac trauma (C1) • Able to understand and explain the pathophysiology of the disease (C2) • To differentiate other pathological conditions mimicking similar clinical presentation based on history and clinical examination (C3) • Able to provide classification of cardiac trauma (C4) • Explain the structural and functional changes secondary to cardiac trauma by ECG and 2D echocardiographic imaging (C5) • To develop knowledge in early diagnosis of disease by providing precise information on management (C5)	2
	Total	**45**

Learning Strategies	Contact Hours	Out of class engagement
Lecture	28	-
Seminar	8	-
Revision	5	-
Assessment	4	-
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Assignments/Presentations	Mid Semester Exam
Record Book	End Semester Exam

Learning Strategies, Contact Hours and Out of class engagement :

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	-	-
Assignments/Presentations	-	-	x	x
Record Book	-	x	x	x
End Semester Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Feigen Baum's Echocardiography 2. Manual of cardiovascular medicine – Brian P Griffin			
Additional References	3. Comprehensive text book of Echocardiography			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Congenital Heart Disease - II**
Course Code	**CVT3303**
Academic Year	Third
Semester	V
Number of Credits	3
Course Prerequisite	Basic knowledge on cardiac anatomy, embryology and cardiac hemodynamics
Course Synopsis	This module will cover embryology, anatomy, classification, pathophysiology, and clinical presentation of all cyanotic congenital heart diseases and complex heart anomalies. The course aims to help students understand the diagnostic methods for diagnosing and managing cyanotic congenital heart disease.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Understand complex congenital heart diseases' embryology, anatomy, classification, and pathophysiology. (C2)
CO2	Understand the clinical presentation, Clinical evaluation, ECG, X-ray, echo, and cath findings of complex congenital heart disease. (C2)
CO3	Understand the natural history, prognosis, and management of complex congenital heart disease. (C2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x		x	x				
CO3	x					x		

Course Content and Outcomes:

Content	**Competencies**	**Number of Hours**
Unit 1		
Decreased pulmonary blood flow (PBF)	• Brief pathophysiology of congenital heart diseases with decreased PBF(C2) • To know the clinical presentation of prognosis of patients with decreased PBF at different ages. (C1)	1
Unit 2		
Tetralogy of Fallot (TOF)	• To know the prevalence and types(C1) • Explaining the embryology, classification and	4

Content	Competencies	Number of Hours
	pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	
Unit 3		
TOF Variants- TOF with pulmonary atresia	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology (MAPCA classification) (C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	3
Unit 4		
TOF with absent pulmonary valve and dysplastic valve	• To know the prevalence and types(C1) • Explaining the embryology, and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	1
Unit 5		
Pulmonary atresia with intact ventricular septum (PAIVS)	• To know the prevalence and types(C1) • Explaining the embryology, classification (Unipartite, bipartite, tripartite RV) and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	2
Unit 6		
Double outlet right ventricle (DORV)	• To know the prevalence and types(C1) • Explaining the embryology, classification (Based on VSD location and Great artery relation) and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis	4

Content	Competencies	Number of Hours
	and management(C3)	
Unit 7		
Complete transposition of great artery (DTGA)	• To know the prevalence and anatomy(C1) • Explaining the embryology, associated anomalies and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 8		
Congenitally corrected transposition of great artery (cCTGA / LTGA)	• To know the prevalence and anatomy(C1) • Explaining the embryology, associated anomalies and pathophysiology(C1) • Understand the clinical presentation, Clinical evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	4
Unit 9		
Tricuspid atresia	• To know the prevalence and types(C1) • Explaining the embryology, classification and pathophysiology(C1) • Understand the clinical presentation, Clinical • evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management(C3)	5
Unit 10		
Hypoplastic left heart syndrome (HLHS)	• To know brief anatomy, embryology, classification/ variants, clinical presentation, diagnosis and management of HLHS (C2) • Understand the difference between hypoplastic and rudimentary left ventrcile (C2)	2
Unit 11		
Single ventricle/ Univentricular heart	• To know the prevalence and brief pathophysiology(C1) • Explaining the embryology and anatomy(C1) • Variants like Double inlet LV, Atresia of one of the AV valves, Unbalanced AVCD and Hypoplasia of on ventricle • To know Shone's complex (C1) • Understand the clinical presentation, Clinical	4

Content	Competencies	Number of Hours
	evaluation, ECG, X ray, echo findings and cath findings(C3) • To understand the natural history, prognosis and management- Both palliative and corrective (Fontan surgery) (C3)	
Unit 12		
Truncus arteriosus	• To understand prevalence, pathophysiology, classification, diagnosis and management of Truncus arteriosus (C2)	2
Unit 13		
Ruptured sinus of Valsalva (RSOV)	• To understand prevalence, pathophysiology, classification, diagnosis and complication of aneurysmal sinus of valsalva (C2) • Brief pathophysiology, diagnosis and management of RSOV (C3)	2
Unit 14		
Aortic arch anomalies	• To understand prevalence, classification, pathophysiology diagnosis and management of aortic arch anomalies (C2)	3
Unit 15		
Coronary anomalies	• To know brief anatomy, embryology, classification/ variants, clinical presentation, diagnosis and management of coronary anomalies (C2)	1
Unit 16		
Palliative shunts	• Indication, anatomic connections, advantages and disadvantages of Aorto-pulmonary shunts (C2) • Classic and modified Blalock Taussig (BT) shunt • Potts shunt • Waterston's shunt/ Cooley shunt • Central shunt	2
	• Indication, anatomic connections, advantages and disadvantages of Cavo pulmonary shunts (C2) • Glenn shunt (Unilateral unidirectional, unilateral bidirectional, bilateral bidirectional)	1
	Total	**45**

Learning Strategies, Contact Hours, and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	30	-
Seminar/ Assignment	10	-
Revision	3	-
Assessment	2	-
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Assignment/presentation	Mid Semester Exam
	End Semester Exam

Mapping of Assessment with COs:			
Nature of Assessment	**CO1**	**CO2**	**CO3**
Mid-Semester Exam	x	x	-
Assignments/Presentations	-	x	x
End Semester Exam	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Moss & Adams' Heart Disease in Infants, Children, and Adolescents: Including the Fetus and Young Adult 2. Park's Pediatric Cardiology for Practitioners: 7th Edition 3. A Comprehensive Approach to Congenital Heart Diseases: (a Lifelong Odyssey) by I.B. Vijayalakshmi

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Valvular Heart Disease**
Course Code	**CVT3304**
Academic Year	Third
Semester	V
Number of Credits	3
Course Prerequisite	Basic understanding of cardiovascular diseases and clinical assessment techniques
Course Synopsis	This course provides insights into the link between cardiac valve anatomy and its clinical implications in diseased conditions. Students will develop skills to identify and assess diseased valves, utilizing echocardiographic techniques for severity assessment. By the end of the course, students will gain expertise essential for the effective diagnosis, severity assessment, and management of valvular heart diseases in clinical practice.

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	To memorize the common etiologies and echocardiographic assessment parameters with an understanding of the pathology and pathophysiology of a given valve disease. (C1, C2)
CO2	Ability to distinguish similar pathological conditions and classify disease types using echocardiography utilizing multiple echo views to locate lesions effectively. (C3, C4)
CO3	Able to put together all the echocardiographic findings in diseased valve condition and comment on the severity of the lesion (C5)
CO4	To build up knowledge in identifying the possible treatment and its outcome (C6)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x							
CO2	x					x		
CO3	x					x		
CO4	x		x					

Course Content and Outcomes:

Content	Competencies	Number of Hours
Unit 1		
Rheumatic Fever	• Able to understand and explain the pathophysiology (C2) • To identify and differentiate rheumatic fever from other conditions with their clinical presentation (C3) • To identify the valve pathology by 2D echocardiography and assess the severity (C5) • To build knowledge in identifying the treatment of choice considering patients benefits (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	3
Unit 2		
Mitral Stenosis	• Able to list the possible causes and define Mitral stenosis (C1) • Able to understand and explain the pathophysiology of mitral stenosis (C2) • To identify and differentiate mitral stenosis from other conditions that mimic similar clinical presentation (C3) • To further evaluate the diseased state by analysing the root pathological cause (C4) • Build knowledge in the application of diagnostic methods to assess severity (C5) • To add a valuable comment on decision-making before intervention (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	4
Unit 3		
Mitral Regurgitation	• Make a list of the possible causes and define mitral regurgitation (C1) • Able to understand and explain the pathophysiology of mitral incompetency (C2) • To differentiate MR from other conditions that mimic similar clinical presentation (C3) • To discover new findings and correlate with existing MR (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of MR (C5) • Make a firm diagnosis in view of further management (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	4

Content	Competencies	Number of Hours
Unit 4		
Aortic stenosis	• List of the possible causes and define Aortic stenosis (C1) • Able to understand and explain the pathophysiology of aortic stenosis (C2) • To differentiate AS from other conditions that mimic similar clinical presentation (C3) • To discover new findings which may add up the diagnosis of AS (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of AS (C5) • Able to make a valuable decision on treatment and evaluate them post procedural (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	4
Unit 5		
Low flow low gradient AS	• To understand and explain the terms Low flow low gradient AS (C2) • To apply the previously learned methods to assess the severity of aortic valve stenosis (C3) • To understand the physiology in low flow AS to AS with preserved LV function (C4) • To interpret the results obtained from the test to baseline results (C5) • To evaluate and comment on the lesion severity and opine on management (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	4
Unit 6		
Aortic regurgitation	• To make a list of the causes and define aortic regurgitation (C1) • Able to understand and explain the pathophysiology of Aortic insufficiency (C2) • To differentiate AR from other conditions that mimic similar clinical presentation (C3) • To discover new findings which may add up the diagnosis of AR (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of AR (C5) • Able to make a valuable decision on treatment and evaluate them post procedural (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	4

Content	Competencies	Number of Hours
Unit 7		
Pulmonary stenosis	• To make a list of the possible causes and define Pulmonary stenosis (C1) • Able to understand and explain the pathophysiology of PS (C2) • To differentiate PS from other conditions that mimic similar clinical presentation. • To discover new findings which may add up the diagnosis of PS (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of PS (C5) • Able to make a valuable decision on treatment and evaluate them post-procedural (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	3
Unit 8		
Pulmonary regurgitation	• To make a list of the possible causes and define PR (C1) • Able to understand and explain the pathophysiology of PR (C2) • To differentiate PR from other conditions that mimic similar clinical presentation (C3) • To identify new findings which may add up the diagnosis of PR (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of PR (C5) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	3
Unit 9		
Tricuspid Stenosis	• To make a list of the possible causes and define TS (C1) • Able to understand and explain the pathophysiology of TS (C2) • To differentiate TS from other conditions that mimic similar clinical presentation (C3) • To identify new findings which may add up the diagnosis of TS (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of TS (C5) • Able to make a valuable decision on treatment and evaluate them post procedural (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	3

Content	Competencies	Number of Hours
Unit 10		
Tricuspid Regurgitation	• To make a list of the possible causes and define TR (C1) • Able to understand and explain the pathophysiology of TR (C2) • To differentiate TR from other conditions that mimic similar clinical presentation (C3) • Identify new findings which may add up the diagnosis of TR (C4) • Build knowledge in application of 2D diagnostic methods to assess severity of TR (C5) • Able to make a valuable decision on treatment and evaluate them post procedural (C6) • Recall ACC/AHA guidelines in the grading of severity of the diseases (C2)	3
Unit 11		
Infective Endocarditis	• To make a list of the possible causes and define IE (C1)	4
	• Able to understand and explain the pathophysiology of infective endocarditis (C2) • To differentiate endocarditis from other conditions that mimic similar clinical presentation (C3) • To identify new findings which may add up the diagnosis of IE (C4) • To build knowledge in application of multiple 2D views to localize the lesion (C5) • To make a confirmed diagnosis and evaluate other conditions pre procedural (C6)	
Unit 12		
Prosthetic valve	• To define and list possible causes for implantation of valve (C1) • To classify the types, understand and explain the functioning of valves (C2) • To differentiate prosthetic valves anatomically and functionally (C3) • To identify new findings that add up in diagnosis (C4) • To evaluate prosthetic valve function and complications by echocardiography (C3) • To know the anticoagulation therapy targets post-prosthetic valve implantation (C1)	4
Unit 13		
ACC/AHA Guidelines for	• To know the guidelines and its importance (C1) • Understand and explain the learned guideline (C2)	2

Content	Competencies	Number of Hours
valvular surgery	• To apply the learned guidelines in any given valvular heart disease (C3) • To obtain echocardiographic data and compare it with the guidelines (C4) • To compile the echocardiographic data and guidelines to comment on disease severity (C5) • To come up with a valuable decision that helps in decision-making (C6)	
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement					
Learning Strategies	**Contact Hours**	**Out of class engagement**			
Lecture	35	-			
Seminar	5	-			
Revision	3	-			
Assessment	2	-			
Total	**45**	**45**			
Assessment Methods:					
Formative:	**Summative:**				
Unit Test	Mid Semester Exam				
Assignments/Presentations	End semester Exma				
Mapping of Assessment with COs:					
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	
Mid-Semester Exam	x	x	-	-	
Assignments/Presentations	-	-	x	x	
End Semester Exam	x	x	x	x	
Feedback process:	End-Semester Feedback				
Main Reference:	• Otto CM. Textbook of clinical echocardiography. Elsevier Health Sciences; 2013 Apr 25. • Armstrong WF, Ryan T. Feigenbaum's echocardiography. Lippincott Williams & Wilkins; 2012 Feb				
Additional References	• Textbook of cardiology by Gee K Oh Tajik				

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**CLINICS - V**
Course Code	**CVT3305**
Academic Year	Third
Semester	V
Number of Credits	4
Course Prerequisite	Students should be able to recall, revise, and understand the basic concepts of non-invasive and invasive diagnostic imaging with its applications in clinical practice
Course Synopsis	This course provides detailed knowledge about echocardiographic assessment of basic cardiac anatomy, develops skills in obtaining basic echocardiographic views, and identification of structural and congenital heart diseases in a systematic manner. This course also includes exposure to diagnostic and therapeutic cardiac catheterization and interventional procedures. By the end of this course, students will be able to recall, understand, and describe the Basic echocardiographic examination, Catheterization procedural guidelines, and common cardiac hardwares used during cardiac catheterization

Course Outcomes (COs):
At the end of the course student shall be able to develop clinical skill:

CO1	To perform echocardiography individually and explain the respective structure independently in valvular, ischemic and congenital heart disease (C2, P4)
CO2	To build up knowledge in selecting appropriate hardware for respective cardiac procedures (C3,P3)
CO3	To compare the normal cardiac structures with diseased conditions in respective views and grade its severity (C4,P5)
CO4	To select the desired cardiac hard wares and explain the advantages and disadvantages for the same(C5,P5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1		x					x	
CO2		x	x	x				
CO3		x	x		x	x		
CO4		**x**					x	x

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
ECG	• Should list the basic steps in the interpretation of any given ECG (P3) • Able to comment on the management strategy of abnormal ECGs (P4) • Should be aware of technical errors and apply technical skills to overcome them (P4) • Able to correlate ECG with the clinical presentation (P4) • Should assess the severity of arrhythmias and timely management (P4)	15
Unit 2		
TMT	• Should know the standard protocol of performing TMT and use of emergency drugs.(P2) • To clinically correlate patient's symptoms, history with ECG (P4 C2) • To analyse the test results and compare it with the baseline findings (P4 C2) • To build knowledge in TMT interpretation and discuss on the management (P4 C2) • Should develop technical skills in patient rescue during emergency (P4 C2)	25
Unit 3		
Ambulatory ECG	• Should know to utilize different methods of lead placement in recording ECG (P4, C2) • Able to analyse and interpret stored ECG data (P4, C2) • To build knowledge in identifying serious arrhythmias and look for treatment options (P4, C3)	10
Unit 4		
Clinical OPD practice	• Should know to utilize the basic clinical equipment (P4,C2) • Ability to perform activity independently (P5, C3) • To build knowledge in identifying cases with clinical examination (P5, C3) • To perform new skills in performing clinical examination (P5 ,C2)	15
Unit 5		
Bedside rounds	• Should be able to evaluate patient based on	15

Content	Competencies	Number of Hours
	the case history (P2,C1) • Ability to perform basic patient examination steps (P4,C2) • Should perform tasks or activity under the supervision of physician (P4, C3) • Should make a evaluation of a given case based on the routine investigations (P5, C4)	
Unit 6		
Basics of Echocardiography	• To apply the learnt principles of echocardiography during clinical practice (C3, P4) • To build knowledge about ethics and minimize the ethical issues (C1,P2) • Should be able to perform routine echocardiography independently (C3, P5) • Should choose appropriate 2D echo views to visualize LV segments and identify wall motion abnormality (P5,C3) • Should interpret the Doppler studies with newer methods (C3 ,P5)	30
Unit 7		
Pacemaker analysis	• Should classify the type of pacemaker based on the ECG recording (P2, C2) • Able to assess the parameters and their importance during analysis (P4,C2) • To perform pacemaker analysis individually based on the mode implanted (P5, C3) • To add findings based on analysis, history and a frame a new diagnosis (P5, C3) • To diagnose pacemaker related problems and finding an appropriate solution (P6, C3)	15
Unit 8		
Basic cardiac catheterization	• To apply basic principles of X-ray during catheterization procedures (C1, P1) • Should know the purpose of hard wares during routine cardiac procedures (P3, C2) • To observe and know the functioning and mechanism of the hard wares and other equipments (P3, C3) • Should be able to explain step wise approach to any given procedure (P5, C3) • Perform assigned tasks independently (P5, C3) • Should build knowledge in the working principle of equipment and apply during clinical	30

Content	Competencies	Number of Hours
	procedures (P6, C4)	
Unit 9		
Advanced Cardiac catheterization	• Should be aware of the routine angiographic views (P1, C1) • Should understand the drug mechanism and conditions in which its administered (P3, C2) • Should explain advantages and disadvantages of the hard wares and equipment used (P2, C2) • Take part actively in valvar procedure BMV, BPV, BAV (P4, C2) • Should categorize hard wares used for specific valvar / congenital lesions (P5, C3) • Should build knowledge views to visualize defect during the procedure (P6, C4)	25
	Total	**180**

Learning Strategies, Contact Hours and Out of class engagement				
Learning Strategies	**Contact Hours**	**Out of class engagement**		
Clinic	60	-		
Self-directed learning (SDL)	50	-		
Problem-Based Learning (PBL)	20	-		
Case Based Learning (CBL)	40	-		
Total	**180**	**180**		
Assessment Methods:				
Formative:	**Summative:**			
Clinical Record Book	-			
Case presentation	-			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Clinical Record Book	x	x	x	x
Case presentation	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	1. Perloff's Clinical Recognition of Congenital Heart Disease, 7th Edition - June 25, 2022, Ariane Marelli, Jamil Aboulhosn 2. Cardiac catheterization: Grossman And Baims Cardiac Catheterization Angiography And Intervention 9 Edition, 2023			

SEMESTER- VI

COURSE CODE	:	COURSE TITLE
CVT3401	:	Applications of Echocardiography
CVT3402	:	Cardiac Cath and Interventions
CVT3403	:	General Cardiac Examination and BLS - ACLS
CVT3404	:	Practicals in Cardiac Cath and Imaging
CVT3405	:	Clinics - VI
CVT3406	:	Program elective - II : Cardiac Assist Devices
CVT3407	:	Program elective - II : Imaging Modalities in Cardiac Diagnosis

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Applications of Echocardiography**
Course Code	**CVT3401**
Academic Year	Third
Semester	VI
Number of Credits	4
Course Prerequisite	Basic knowledge about Cardiovascular diseases, Congenital & Valvular heart disease, Hemodynamics, Instrumentation of Ultrasound and Doppler principles
Course Synopsis	This course covers various Echocardiographic modalities in the overall assessment of cardiac structure, function, and pathologic conditions. The course provides comprehensive knowledge on diagnosis and hemodynamic assessment of various cardiovascular diseases. By the end of this course, students will have a comprehensive understanding of complete echocardiographic examination and evaluation methods in patients with cardiac diseases.

Course Outcomes (COs):
At the end of the course student shall be able to: Build knowledge and utilize

CO1	To identify and understand the abnormal & normal M –Mode patterns in various cardiac diseases and various methods of ventricular systolic/diastolic function assessment (C4)
CO2	To understand the physical instrumentation, modalities and clinical applications of TEE and 3D echocardiography **and contrast echocardiography (C3)**
CO3	To build knowledge to understand the anatomy & hemodynamics and diagnostic evaluation of Congenital Heart Disease**, valvular Heart diseases, myocardial, pericardial and aortic diseases** by echocardiography(C5)
CO4	To understand and build knowledge on advanced echocardiographic techniques such as Tissue doppler imaging, tissue deformation imaging,(Strain, strain rate, torsion) and Tissue synchronization techniques with the clinical applications(C5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x						x	
CO2	x						x	
CO3	x					x	x	x
CO4	x					x	x	x

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
M- mode echocardiography	• Identify and explain the normal and abnormal motion patterns at Left ventricular, mitral valve and aortic valve level M-mode(C5) • Identify and explain the M- mode patterns in normal and in diseased condition of Mitral Valve, Pulmonary valve and Aortic valve(C5) • Identify and explain the normal and abnormal Mmode pattern of Tricuspid Annular Plane Systolic Excursion and Inferior Vena cava(C5) • Explain the applications of M-mode in Left Ventricular systolic and diastolic function assessment(C5)	2
Unit 2		
Color M-mode	• Explain the applications of Color M-mode in Aortic, Mitral regurgitation, Velocity propagation and LV dyssynchrony(C2)	2
Unit 3		
Assessment of LV systolic function	• To Understand and apply the M-Mode and 2D techniques in the assessment of LV systolic function assessment (C5) • To evaluate LV Ejection fraction by various methods (C5) • To apply various LV volumetric assessment methods (C5) • To understand the Doppler echo technique in the assessment of LV systolic function(C2) • To know the role of TDI and tissue deformation imaging in the assessment of LV systolic function(C2) • To know the steps involved in 3D echo in the LV systolic function assessment (C2)	3
Unit 4		
Assessment of LV diastolic dysfunction	• To Understand and apply the M-Mode and 2D techniques in the assessment of LV diastolic function assessment (C5) • To evaluate LV diastolic function Grading by various methods (C5) • To understand the Doppler echo technique used across MV and Pulmonary venous flow in the assessment of LV diastolic function(C4) • To know the role of LA function in the assessment of LV diastolic function(C2) • To understand the use of TDI in the	3

Content	Competencies	Number of Hours
	assessment of LV diastolic dysfunction(C3) • To understand the velocity propagation of mitral inflow doppler in the assessment of LV diastolic dysfunction (C2)	
Unit 5		
Assessment of RV function	• To Understand and apply the M-Mode and 2D techniques in the assessment of RV function assessment (C5) • To evaluate RV Ejection fraction and fractional area change by various methods (C5) • To understand the Doppler echo technique in the assessment of RV function(C2) • To know the role of TDI and tissue deformation imaging in the assessment of RV systolic function(C2) • To know the steps involved in 3D echo in the RV function assessment (C2) • To know the role of IVC imaging and Hepatic venous Doppler in the assessment of RV function(C2)	3
Unit 6		
Transesophageal echocardiography (TEE)	• List and Explain the Indications, Contraindication and Complications of TEE(C2) • Outline the Instrumentations, Monoplane, Biplane and Multiplane probes (C2) • Summarize and Explain the examination techniques including Patient preparation, Probe insertion and Technical problems (C2) • Apply skills to Identify and Explain the Multiplane Transesophageal echocardiography imaging views(C2)	2
Unit 7		
3D echocardiography (3DE)	• List the steps involved in 3D imaging technology(C4) • Explain the clinical applications in assessment of left ventricle, right ventricle, mitral valve, tricuspid valve, aortic valve, pulmonary valve, Interatrial septum and left atrial appendage(C5)	2
Unit 8		
Contrast echocardiography	• List the indications of contrast echocardiography(C4) • List the properties of Ideal contrast agent(C4)	2

Content	Competencies	Number of Hours
	• Summarize the ultrasound interaction with contrast agent(C2) • Explain the clinical applications of contrast echocardiography in various diseased condition(C5) • Explain Myocardial contrast echocardiography(C5)	
Unit 9		
Echo in congenital heart disease	• Examine and Explain the 2DE, M-mode, Hemodynamic and Doppler patterns in Pre tricuspid shunt(C5) • Examine and Explain the 2DE, M-mode, Hemodynamic and Doppler patterns in Post tricuspid shunts(C5) • Examine and Explain the 2DE, M-mode, Hemodynamic and Doppler patterns in Increases pulmonary blood flow(C5) • Examine and Explain the 2DE, M-mode, Hemodynamic and Doppler patterns in Decreased pulmonary blood flow(C5) • Examine and Explain the 2DE, M-mode, Hemodynamic and Doppler patterns in Pulmonary venous anomalies(C5) • Identify and Explain straddling/ overriding(C5)	12
Unit 10		
Echo in valvular heart disease	• Identify and Explain the 2DE,M-mode,Doppler pattern and methods to assess the severity grades of Mitral valve disease(C5) • Identify and Explain the 2DE,M-mode,Doppler pattern and methods to assess the severity grades of Aortic valve disease(C5) • Identify and Explain the 2DE,M-mode,Doppler pattern and methods to assess the severity grades of Tricuspid valve disease(C5) • Identify and Explain the 2DE,M-mode,Doppler pattern and methods to assess the severity grades of Pulmonary valve disease(C5)	8
Unit 11		
Echocardiography in pulmonary hypertension	• Identify and Explain the 2- Dimensional • Echocardiography (2DE) and M–mode findings in pulmonary hypertension(C5) • Identify and Explain the Doppler flow pattern and its limitations(C5) • Methods to measure Right atrial pressure(C5)	3

Content	Competencies	Number of Hours
Unit 12		
Echo in cardiomyopathies	• Identify and Explain the 2DE, M –mode, Conventional Doppler, TDI and recent advance techniques to assess Dilated cardiomyopathy(C5) • Identify and Explain the 2DE, M –mode, Conventional Doppler, TDI and recent advance techniques to assess Restrictive cardiomyopathy(C5) • Identify and Explain the 2DE, M –mode, Conventional Doppler, TDI and recent advance techniques to assess Hypertrophied cardiomyopathy(C5) • Identify and Explain the 2DE, Color and Doppler Findings to assess LV non compaction(C5)	5
Unit 13		
Echo in cardiac mass and tumors	• Build skills to identify and classify the type of cardiac tumors by location and appearance in 2DE and Doppler criteria(C5) • Identify and Examine the cardiac mass by 2DE criteria(C5)	2
Unit 14		
Echo in pericardial diseases	• Examine and Evaluate the 2DE criteria to identify Congenitally absent pericardium and pericardial cyst (C5) • Identify and Explain the 2DE, M-mode, Conventional Doppler, TDI criteria and recent advance techniques to distinguish Pericardial effusion and Cardiac Tamponade(C5) • Apply the technique in evaluating Echocardiographyically guided Pericardiocentesis(C5) • Identify and Explain the 2DE, M-mode, Conventional Doppler, TDI criteria and recent advance techniques in Constrictive pericarditis(C5) • Identify and Explain the 2DE, M-mode, Conventional Doppler, TDI criteria and recent advance techniques to distinguish Restrictive vs constrictive physiology(C5)	3
Unit 15		
Tissue Doppler imaging(TDI)	1.Build skills in Analysing, Measuring and Evaluating the Tissue annular velocity(C5) 2.Build skills in Analysing, Measuring and	2

Content	Competencies	Number of Hours
	Evaluating the Myocardial Strain and Strain rate (C5) 3.Build skills in Analysing, Measuring and Evaluating the Tissue dyssynchrony imaging (C5)	
Unit 16		
Echo in aortic diseases	1.Analyse and Evaluate the location of Aortic aneurysm by 2DE, Doppler parameters and recent advanced techniques to make of the values to decide on management(C5) 2.Analyse, Evaluate and classify based on location of Aortic dissection by 2DE, Doppler parameters and recent advanced techniques to make of the values to decide on management(C5)	2
Unit 17		
Tissue Doppler echocardiohgraphy and Echo in Dyssynchrony	**1.** Introduction to Tissue doppler imaging 2. Analyse and Explain the Conventional Doppler & TDI measures to assess interventricular dyssynchrony(C5) 3.Analyse and Explain the M-mode, Color M-mode, Conventional Doppler, TDI, Speckle tracking and Tissue synchronization imaging measures to assess intraventricular dyssynchrony(C5) 4.Analyse and Explain the Doppler parameters to measure Atrio-ventricular dyssynchrony(C5)	2
Unit 18		
Tissue deformation imaging	1. Apply techniques in analyzing the methods to assess Automated Function Imaging (C5) 2.Apply technique in analysing the methods to assess Strain and strain rate(C5) 3.Apply technique in analysing the methods to assess LV torsion(C5)	2
Total		**60**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	50	-
Seminar	10	-
Total	**60**	**60**

Assessment Methods:				
Formative:	Summative:			
Assignments	Mid Semester Exam			
Presentations	End semester Exam			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	x	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x
Feedback Process:	**End-Semester Feedback**			
Main Reference:	1. Feigenbaum's Echocardiography (Latest Edition) 2. Principles and Practice of Echocardiography by Arthur Weyman 3. The Echo Manual by Gee K Oh Tajik (Latest Edition) Textbook of Clinical Echocardiography by Catherine Otto (Latest edition)			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Cath and Interventions**
Course Code	**CVT3402**
Academic Year	Third
Semester	VI
Number of Credits	4
Course Prerequisite	Basic knowledge about Hardwares used in cardiac interventional suits, X-Ray physics, cardiac invasive hemodynamic measurement techniques, contrast agents, and cardiac pharmacology
Course Synopsis	This course explores the applications of cardiovascular technology in diagnosing and treating cardiac diseases. Students will learn the principles of cardiac catheterization, hemodynamic measurements, and advanced interventional techniques used in the management of complex cardiovascular conditions. By the end of the course, students will have gained the knowledge and skills needed to assist in cardiac catheterization and intervention procedures effectively.

Course Outcomes (COs):
At the end of the course, student shall be able to:

CO1	To apply the knowledge in understanding the diagnostic and therapeutic procedures like angiography and angioplasty and basic electrophysiology studies (C3)
CO2	To understand the diagnostic and interventional techniques of valvular and congenital heart diseases (C3)
CO3	To construct knowledge on the use of interventional hardwares in various procedures like cardiomyopathy interventions, pericardiocentesis, and peripheral vascular diseases (C4)
CO4	To understand the various procedural techniques like rotablation and IVL and to interpret the results using various diagnostic modalities like FFR, IVUS, and OCT (C4)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x		x	x				
CO3	x		x	x				
CO4	x				x	x	x	

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Coronary vascular system	• Understanding the formation of atherosclerotic plaque(C2) • Define and explain the coronary artery and venous anomaly(C2) • Understanding the benign and malignant coronary anomalies(C2)	3
Unit 2		
Coronary Angiography	• To identify the importance of ACC/AHA guidelines for coronary angiography(C3) • To know about choosing the appropriate hardwares for the procedures(C4) • To understand the various techniques and angiographic views(C2) • To interpret the angiographic results in coronary artery disease(C5) • To illustrate the complications of all interventional procedure(mechanical and procedural related) and its management (C3)	3
Unit 3		
Coronary Angioplasty	• To identify and understand the lesion Classification (C3) • To apply and understand the techniques and hardware used in primary angioplasty procedure(C3) • To apply and understand the techniques of adjuvant PCI using IABP, VADs, ECMO and Impella (C4) • To apply and understand the techniques of complex PCI like Bifurcation lesions, LMCA,CTO's, DVD,TVD and MVD(C4) • To apply and understand the techniques of conventional PCI(C3)	4
Unit 4		
Diagnostic Cath and Angiography in understanding various CHDs, VHDs, and cardiomyopathies.	• Determine the importance of cardiac ventriculography and procedural techniques in evaluating various heart diseases(C4) • Determine the importance of Aortogram and PA angiogram in evaluating various heart diseases(C4) • To understand the criteria in interpreting various cardiac angiograms(C4)	5

Content	Competencies	Number of Hours
Unit 5		
Cardiac Cath and intervention in CHD	• To elaborate the indications , contraindications, hardwares , procedural techniques ,complication and management in ASD and PFO(C4) • To elaborate the indications, contraindications, hardwares, procedural techniques,complication and management in VSD(C4) • To elaborate the indications , contraindications, hardwares , procedural techniques ,complication and management in PDA(C4) • To elaborate the indications , contraindications, hardwares , procedural techniques ,complication and management in RSOV(C4) • To elaborate the indications , contraindications, hardwares , procedural techniques ,complication and management in LAA(C4)	10
Unit 6		
Cardiac Cath and intervention in VHD	• To elaborate the Indications , contraindications, hardwares , procedural techniques ,complication and management in BMV(C4) • To elaborate the Indications , contraindications, hardwares , procedural techniques ,complication and management in BPV(C4) • To elaborate the Indications , contraindications, hardwares , procedural techniques ,complication and management in BAV(C4) • To elaborate the Indications , contraindications, hardwares , procedural techniques ,complication and management in TAVI(C4)	8
Unit 7		
Interventions for Cardiomyopathies	• To elaborate the indications , contraindications, hardwares , procedural techniques ,complication and management in endomyocardial biopsy (C4) • To elaborate the indications, contraindications, hardwares , procedural techniques ,complication and management in PTSMA/ASA (C4)	4
Unit 8		
Cardiac cath and angiography in peripheral vascular diseases	• To define and understand various types and diseases of peripheral vascular system(C2) • To explain the angiographic Hardwares (catheters, stents, balloons) and procedure in PVD's (C3) • To understands the classification of PVDs (C2) • To identify the strategy for procedure related complications(C2) • To explain the use of snare kit in management of	6

Content	Competencies	Number of Hours
	complications (C2) • Elaborate the indications , steps and procedure of IVC filter implant (C2) • To illustrate the classification and procedural uses of embolic protection devices (C2)	
Unit 9		
Pericardiocentesis	• To explain the indications and contraindications (C2) • To elaborate the steps in the procedure (C3) • To interpret the sample obtained and categorise the results (C3)	2
Unit 10		
Fractional Flow Reserve	• To outline the indications and contraindications (C2) • To demonstrate the importance of achieving hyperemia during FFR (C3) • To understand the role of FFR by its equipment and technique of working principle (C3)	2
Unit 11		
Intravascular ultrasound And Optical Coherence Tomography	• To outline the indications and contraindications (C2) • To understand the role of IVUS and OCT by its equipment and technique of working principle (C3) • To explain the instrumentation and methods to handle (C3) • To interpret the images obtained and its advantages (C3)	6
Unit 12		
Rotablation and Intravascular lithotripsy	• To outline the indications and contraindications (C2) • To understand the role of ROTA and IVL by its equipment and technique of working principle (C3) • To explain the instrumentation and methods to handle (C3) • To understand the complications and its management (C3)	5
Unit 13		
Introduction to EP studies	• To outline the indications and contraindications (C2) • To explain the common views and catheter placements (C2) • To remember the normal intervals and values in EP studies(C2)	2
	Total	**60**

Learning Strategies, Contact Hours, and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	50	-
Seminar	5	-
Revision	3	-
Assessment	2	-
Total	**60**	**60**

Assessment Methods:	
Formative:	**Summative:**
Assignments/Presentations	Mid Semester Exam
	End Semester Exam

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x

Feedback Process:	End-Semester Feedback
Reference:	1. Textbook of Interventional Cardiology – By Grossman 2. Manual of cardiovascular medicine – By Griffin 3. Handbook of Interventional Cardiology – Morten J kern

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**General Cardiac Examination and BLS-ACLS**
Course Code	**CVT3403**
Academic Year	Third
Semester	VI
Number of Credits	3
Course Prerequisite	Basic knowledge on evaluating cardiac diseases with clinical aspects
Course Synopsis	This course includes the cardiovascular clinical examination through medical history, a detailed examination of the heart, and the peripheral arterial and venous circulations. This module provides the brief steps involved in the assessment of clinical scenarios, clinical findings, and their association with diagnostic test results. Students will gain knowledge on basic Life Support and assess the various scenarios of cardiac arrest and respiratory arrest as well as life-threatening arrhythmias and its immediate management.

Course Outcomes (COs): **At the end of the course student shall be able to:**	
CO1	Understand the cardiac symptoms and its cardiac and non-cardiac etiology(C3)
CO2	Understand Instrumentations, Indications and Methods of performing the test in the evaluation of syncope(C4)
CO3	Understand the etiology and evaluation of hypertension (systemic & pulmonary hypertension)(C3)
CO4	Understand cardiac and respiratory arrest; Its immediate response using basic life support and advanced cardiac life support algorithms(C5, P5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x		x	x				
CO3	x					x		
CO4	x	x		x	x		x	

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
History taking	• Identify the normal and abnormal patient history (C3)	2

Content	Competencies	Number of Hours
	• Identify the clinical findings and comparing these with the diagnostic tests (C3)	
Unit 2:		
NYHA functional class	• To identify and understand the different NYHA functional class(C3)	1
Unit 3		
Chest pain	• To know the etiology, Cardiovascular causes and Non Cardiac causes (C1) • Explaining the duration, radiation,location and character (C1) • To understand the Chronic stable angina and Unstable angina (C3)	2
Unit 4		
Palpitation	• To understand the Cardiac etiology and evaluation (C3) • To understand the Non-Cardiac etiology and evaluation (C3)	2
Unit 5		
Fatigue	• To understand the cardiac and noncardiac etiology and evaluation(C3)	1
Unit 6		
Syncope	• To understand the Cardiac etiology and evaluation (C3) • To understand the Non-Cardiac etiology and evaluation (C3) • To understand the clinical examination of patients with syncope (C1)	2
Unit 7		
Tilt Table Testing	• To understand Instrumentations, Indications, and Methods of performing the test(C3) • To interpret the tilt table test results, whether Positive / negative (C5)	2
Unit 8		
Dyspnea	• To understand etiology, Cardiovascular causes and Non-Cardiac causes(C3) • Explaining the pathogenesis(C1) • To know the Paroxysmal nocturnal dyspnea and Orthopnea(C1)	2
Unit 9		
Artererial pulse	• To know the Definition, Genesis and Pulse wave pattern(C1) • Explain the examination of arterial pulse, • Irregularly irregular pulse, Regularly irregular pulse, Pulsus paradoxus ,Volume of the	3

Content	Competencies	Number of Hours
	pulse(C1) • Understand the characteristic features of pulse in common clinical conditions(C3)	
Unit 10		
Jugular venous pulse	• Identify and understand the waves of JVP in normal and abnormal –conditions(C5)	3
Unit 11		
Heart sound	• Identify and understand the normal and disease conditions(C5) • Identify and understand the Heart murmur in various disease and conditions(C5)	2
Unit 12		
Hemoptysis	• To know the etiology and evaluation(C1)	1
Unit 13		
Hoarseness of voice	• To know the etiology and evaluation(C1)	1
Unit 14		
Cyanosis	• To know the definition and evaluation(C1) • Explain the types: Peripheral cyanosis, Central cyanosis, Mixed cyanosis and differential cyanosis(C1)	2
Unit 15		
Hypertension	• To know the etiology and types(C1)	2
Unit 16		
Pulmonary artery hypertesion	• To know the etiology and diagnosis(C1)	4
Unit 17		
Basic life support	• To know the introduction, course objectives, age definition, high quality CPR, in hospital /out of hospital cardiac arrest and sudden cardiac arrest verses heart attack(C1) • Explaining the adult cardiac arrest algorithm, adult rescuer BLS sequence, assessment of breathing and pulse, locating carotid pulse, adult chest compression, adult breaths, head tilt chin lift, jaw thrust, barrier devices, bag-mask devices ,rescuer task in one or two rescuer(C1) • Explain the AED for adults and children, special circumstances and universal steps of operating AED (C1) • Understand the Team dynamics(C3,P3) • Explain the BLS for infants and children(C1, P4) -Infants/child chest compression -Paediatric cardiac arrest algorithm	5

Content	Competencies	Number of Hours
	• Explain the ventilation techniques(C1) • 7Understand the opioid associated life threatening emergencies(C3,P3)	
Unit 18		
Advanced cardiac life support	• To know the introduction, ECG rhythm interpretation for core ACLS rhythms(C1) • Understanding the effective high performance team dynamics, clear roles and responsibilities, knowledge sharing, clear messages and closed loop communication(C3,P5) • Understanding the ACLS cases , management of respiratory arrest, airway management , hardwares in airway management, acute coronary syndrome, acute stroke and fibrinolytic therapy(C3,P5) • Understanding the cardiac arrest , adult cardiac arrest algorithm, pulseless electrical activity, cardiac asystole, Bradycardia, Tachycardia, adult tachycardia with pulse algorithm and post cardiac arrest algorithm(C3,P5)	8
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	28	-
Problem based learning	10	-
Revision	4	-
Assessment	3	-
Total	**45**	**45**

Assessment Methods:				
Formative:		**Summative:**		
Assignments/Presentations		Mid Semester Exam		
Clinical assessment (OSPE)		End semester Exam		
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester Exam	x	x	x	x
Feedback Process:	End-Semester Feedback			

Main Reference:	1. Clinical Examinations in Cardiology, Book by B. N. Vijay Raghava Rao 2. Braunwald's Heart Diseases: A Textbook of Cardiovascular Medicine
Additional References	1. Alagappa's text book of Clinical Cardiology 2. ACC/AHA guidelines for ACLS and BLS

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Practicals in Cardiac Cath and Imaging**
Course Code	**CVT3404**
Academic Year	Third
Semester	VI
Number of Credits	3
Course Prerequisite	Students must possess basic knowledge in the interpretation and identification of ECG changes. They must be conscious about equipment handling and performing basic echocardiography. Students should be aware of the functioning of the cardiac catheterization suite, and consider appropriate precautionary measures regarding equipment handling during the diagnostic testing**.**
Course Synopsis	This course offers clinical observations in various cardiac noninvasive and invasive laboratories. Students will be posted in ECG, TMT, Holter monitoring, pacemaker programming, Echocardiography, Cardiac catheterization and intervention lab, cardiac ICU, and emergency wards on rotation. By the end of this course, students will be obtaining an overview of various cardiac diagnostic tests and management strategies.

Course Outcomes (COs):
At the end of the course, students shall be able to:

CO1	To obtain echocardiographic images concerning the underlying disease and provide supportive findings from medical records in grading the disease severity
CO2	To understand the indication, procedural guidelines, cath lab setup, and aseptic measure to be considered during invasive/noninvasive diagnostic testing and analyze the angiographic findings from the available angiographic and cath data
CO3	To develop skills and proactiveness in equipment handling, hardware selection, emergency drug administration, and effective communication with the cathlab personnel.
CO4	Ability to incorporate ethical principles while conducting diagnostic tests.

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x	x					x	
CO2		x	x	x				
CO3		x	x	x		x	x	
CO4	x							

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Standard echocardiographic examination	• To identify and quantify cardiac function by by using routine echocardiographic evaluation by m-mode, 2D, and Doppler quantification methods. (P5) • To measure and quantify ventricular function, flow velocities and estimation of chamber pressures (P5)	3
Unit 2		
Echo in congenital heart disease (CHD)	• Apply skills to determine the congenital cardiac anomalies (P4) • To classify the specific CHD anatomically and physiologically (P4) • To identify and analyze the direction of shunt, pulmonary to systemic flow ratio, pulmonary and systemic vascular resistance, PA pressure assessment (P4) • To build skills in the evaluation of associated anomalies, cardiac function, chamber enlargement and correlating echocardiographic diagnosis with other clinical parameters. (P4)	5
Unit 3		
Echo in Valvular Heart Disease (VHD)	• To develop skills in identification of valvular stenosis/ regurgitation with its severity assessment (P4) • To diagnose and estimate pressure gradients across the stenotic valve, assessment of valve area, regurgitant volume/fraction (P4) • To evaluate the associated lesions, ventricular function, and pulmonary pressure(P4) • To evaluate and provide supportive findings in patients suspecting with infective endocarditis(P3) • To develop skills in the evaluation of prosthetic heart valves(P3)	8
Unit 4		
Echo in Ischemic Heart disease (IHD)	• To evaluate the patients with suspected coronary artery disease by quantifying global and regional cardiac function (P4) • To build skills in the assessment of patients with acute coronary syndrome and their complications (P4)	5

Content	Competencies	Number of Hours
	• To identify the need for follow-up assessment in patients with prior percutaneous coronary intervention/ CABG (P4)	
Unit 5		
Echo in Cardiomyopathies and pericardial diseases	• To identify and evaluate causes, quantify myocardial function and valvular regurgitation in various types of dilated cardiomyopathies (P4) • To build skills in identifying ECG changes and correlating them with echocardiographic findings using m mode, 2D, and Doppler to quantify the underlying condition(P3) • To outline various etiologies leading to pericardial involvement and their clinical presentation. (P4) • To build skills in the diagnosis of ECG changes in specific types of cardiomyopathies and pericardial diseases and correlation with echocardiographic findings. (P3) • To identify and analyse the role of Doppler quantification methods in differentiating constriction, effusive constrictive pericarditis, and cardiac tamponade (P4)	10
Unit 6		
Echo in Aortic diseases and cardiac tumors	• To identify and analyze the etiologies (primary or secondary) contributing to aortic diseases. (P3) • To build skills in the identification and quantification of aortic etiologies by m mode and 2D quantification and Doppler methods. (P3) • To identify and provide supportive findings in the diagnosis of cardiac tumors, etiologies, and their types. (P3) • To evaluate the site of mass, morphology, mobility, flow obstruction, hemodynamics, and associated anomalies in the setting of cardiac tumors. (P3)	4
Unit 7		
Transesophageal echocardiography (TEE)	• To identify the indication, probe setting, equipment handling, and patient preparation before TEE. (P5) • To assist the procedure, analyze various imaging planes, structures, and data acquisition for further assessment. (P4)	2

Content	Competencies	Number of Hours
Unit 8		
Pharmacological Stress and contrast Echocardiography	• To identify the indication, contraindication, and procedural preparation for DSE. (P3) • To choose the appropriate protocol, and dose adjustment. (P3) • To analyze and interpret the results and conclude on the findings. (P3)	4
Unit 9		
Recent Advances	• To analyse the tissue annular velocity and assess ventricular function using tissue Doppler imaging (P3) To identify the methods to evaluate strain and strain rate echocardiography and their uses (P3) • To build skills in identifying the techniques to generate 3D echocardiography (P3)	4
Unit 10		
Standard guidelines in the interventional suite and equipment handling	• To build skills in following protocols, handling operating able, and implement precautionary measures during patient preparation and patient care. (P5) • To understand the importance of consent for every procedure and follow aseptic precautions (P4) • To develop skills and to assist in handling OCT, FFR, injectors, IVUS and other diagnostic equipments. (P5)	5
Unit 11		
Cardiac catheterization and Intervneitonal hardwares	• To identify the procedural steps and interpretation of diagnostic angiograms (P4) • To build skills in identificationand selection of appropriate hardware for the diagnostic/ therapeutic intervention(P2) • To choose required hardwares for the elective procedure(P5) • To interpret the angiographic results and build knowledge in identifying appropriate management (P5)	8
Unit 12		
Cath study and procedures in structural, coronary and valvular diseases	• To understand procedural steps in valvular, coronary and congenital intervneitons (P4) • To identify and analyse the preparation steps, selection of devices for intervention and appropriate hardware for the underlying lesion (P5)	1

Content	Competencies	Number of Hours
	• To develop skills in chosing appropriate hardware, quantifying lesion seveity and various techniques followed in therapeutic procedures (P5)	
Unit 13		
Miscellaneous cardiovascular interventions	• To identify the steps and procedure of PTSMA in HOCM, pericardiocentesis (P4) • To understand the steps, precuaitons and complications encounetered during peripheral and aortic interventions • (P4) • To understand the steps and procedure of AAAs interventions (P4)	8
Unit 14		
Pacemaker and device implantation procedure	• To interpret the steps, follow aseptic precautions and preparation during implanatation of temporary and permanent Pacemaker implantation (P4) • To identify the necessary hardware and respond actively during the case (P3)	5
Unit 15		
Emergency drug handling	• To analyze the underlying condition, and proactiveness during critical cases and administer emergency cardiac drugs under supervision (P2) • To identify the drug, indications, and contraindications, and to remember and follow the appropriate dosage as per the commands (P4)	6
Unit 16		
Role of echo in Cardiac interventional suit	• To identify the need and echocardiography quickly on emergency instructions (P4) • To build skills in the interpretation the echocardiographic data and guide the interventional and critical procedures under fluro guidance (P4)	12
	Total	**90**

Learning Strategies, Contact Hours and Out of class engagement :		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Practical	60	-
Presentation	15	-
Assignment	15	-
Total	**90**	**90**

Assessment Methods:	
Formative:	**Summative:**
Clinical/Practical Log Book /Work Dairy	Mid-semester examination End semester examination

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester Exam	x	x	x	-
Presentation/ Assignment	-	-	x	x
End semester Exam	x	X	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Echocardiography: Feigenbaum's Echocardiography, Book by Harvey Feigenbaum, 8th edition, 2018, William F. Armstrong, Thomas Ryan. 2. Textbook of Clinical Echocardiography: Book by Catherine Otto, 7th Edition 3. Textbook of Interventional Cardiology-8E Hardcover – 12 November 2019, Eric J Topol 4. Kern's Cardiac Catheterization Handbook: 7th Edition Paperback – Illustrated, 12 December 2019, Paul Sorojja. 5. Manual of Cardiovascular Medicine, November 2018, Brian P Griffin

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**CLINICS - VI**
Course Code	**CVT3405**
Academic Year	Third
Semester	VI
Number of Credits	3
Course Prerequisite	Students should be able to recall, revise, and understand the basic concepts of non-invasive and invasive diagnostic imaging with its applications in clinical practice
Course Synopsis	This course offers clinical observations in various cardiac noninvasive and invasive laboratories. Students will be posted in ECG, TMT, Holter monitoring, Pacemaker programming, Echocardiography, Cardiac catheterization and intervention lab, cardiac ICU, and emergency wards on rotation. By the end of this course, students will be obtaining an overview of various cardiac diagnostic tests and management strategies.

Course Outcomes (COs):
At the end of the course student shall be able to develop clinical skill:

CO1	To understand and evaluate valvular, ischemic and congenital heart disease using all the cardiac non- invasive diagnostic modalities (C2, P4)
CO2	To perform ECG, treadmill stress test independently and assist pacemaker analysis and programming (C3,P3)
CO3	To understand and assist cardiac catheterization procedures and to know the various hardwares that are used during cardiac interventions (C3,P3)
CO4	To develop clinical skills in equipment handling, emergency drug administration, and effective communication with the cathlab personnel.(C3, P5)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1		x					x	
CO2		x	x	x				
CO3		x	x		x	x		
CO4		x					x	x

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
ECG	• Identify and troubleshoot technical errors encountered during ECG monitoring and interpretation, utilizing technical skills to ensure accurate diagnostic outcomes (P4). • Demonstrate proficiency in correlating ECG findings with clinical presentations to enhance diagnostic accuracy and patient management (P4). • Assess the severity of various arrhythmias promptly and accurately, guiding timely intervention and improving patient outcomes (P4). • Implement effective strategies for the management of arrhythmias based on severity assessments, ensuring optimal patient care and safety (P4).	15
Unit 2		
TMT	• Master the standard protocols for conducting Treadmill Testing (TMT) and become proficient in the administration of emergency drugs as per guidelines (P2). • Skillfully correlate patient symptoms and medical history with ECG findings to aid in accurate clinical assessments (P4 C2). • Analyze TMT results meticulously, comparing them with baseline data to identify significant changes and trends (P4 C2). • Develop expertise in interpreting TMT results and formulate comprehensive management plans based on findings (P4 C2).	15
Unit 3		
Ambulatory ECG monitoring	• Demonstrate proficiency in utilizing various methods of lead placement for recording ECGs, ensuring accurate and reliable data collection (P4, C2). • Develop competence in analyzing and interpreting stored ECG data to identify abnormalities and trends for clinical decision-making (P4, C2). • Acquire knowledge and skills in recognizing serious arrhythmias through ECG analysis and exploring appropriate treatment options based on clinical guidelines (P4, C3).	5
Unit 4		
Echocardiographic examination	• Demonstrate proficiency in utilizing basic clinical equipment effectively and accurately during patient examinations, including echocardiographic	30

Content	Competencies	Number of Hours
	procedures (P4, C2). • Achieve the ability to perform echocardiographic examinations independently, demonstrating competence and confidence in interpreting and reporting findings (P5, C3). • Expand knowledge in identifying clinical cases through thorough clinical examination and echocardiographic assessment, applying diagnostic skills to improve patient outcomes (P5, C3). • Develop expertise in performing comprehensive echocardiographic examinations, incorporating new skills and techniques to enhance diagnostic accuracy and inform patient management decisions (P5, C2).	
Unit 5		
Basics of Echocardiography	• Achieve proficiency in independently performing routine bedside echocardiography, demonstrating competence in acquisition, interpretation, and reporting of findings (C3, P5). • Select and utilize appropriate 2D echocardiographic views to visualize left ventricular segments effectively and accurately identify wall motion abnormalities (P5, C3). • Interpret Doppler studies using advanced methods and techniques, applying knowledge to assess hemodynamic parameters and inform clinical decision-making (C3, P5).	15
Unit 6		
Pacemaker analysis	• Classify the type of pacemaker based on ECG recordings, demonstrating proficiency in recognizing and distinguishing various pacemaker modes (P2, C2). • Assess the parameters of pacemaker function during analysis, understanding their significance and implications for patient management (P4, C2). • Independently perform pacemaker analysis based on the implanted mode, accurately interpreting ECG data to evaluate pacemaker performance (P5, C3). • Integrate findings from pacemaker analysis with patient history and clinical data to formulate and communicate a new diagnosis or treatment plan (P5, C3).	10

Content	Competencies	Number of Hours
Unit 7		
Basic cardiac catheterization and coronary interventions	• Understand basic principles of X-ray imaging effectively during cardiac catheterization procedures, ensuring accurate visualization and guidance (C2, P2). • Demonstrate knowledge of the purpose and function of hardware used in routine cardiac catheterization procedures, understanding their role in diagnostic and therapeutic interventions (P3, C2). • Observe and comprehend the functioning and mechanisms of hardware and other equipment used during cardiac catheterization, enhancing understanding of procedural steps and equipment interaction (P3, C3). • Explain a step-by-step approach to performing cardiac catheterization procedures, incorporating knowledge of equipment use and procedural protocols to ensure safe and effective patient care (P5, C3).	25
Unit 8		
Cardiac catheterization and intervention	• Demonstrate proficiency in understanding the mechanisms of drugs used during cardiac catheterization procedures, including indications and contraindications for their administration (P3, C2). • Explain the advantages and disadvantages of hardware and equipment used in advanced cardiac catheterization, integrating knowledge to optimize procedural outcomes (P2, C2). • Actively participate in valvular procedures such as Balloon Mitral Valvuloplasty (BMV), Balloon Pulmonary Valvuloplasty (BPV), and Balloon Aortic Valvuloplasty (BAV), demonstrating competence in procedural techniques and patient management (P4, C2). • Categorize and apply appropriate hardware for specific valvular and congenital lesions during advanced cardiac catheterization, ensuring effective treatment and patient safety (P5, C3).	20
	Total	**135**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Clinic	100	-
Self-directed learning (SDL)	15	-
Problem-Based Learning (PBL)	15	-
Case Based Learning (CBL)	5	-
Total	**135**	**135**

Assessment Methods:	
Formative:	**Summative:**
Clinical Record Book	-
Case Presentation	-

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Clinical Record Book	x	x	x	x
Case Presentation	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	1. Echocardiography: Feigenbaum's Echocardiography, Book by Harvey Feigenbaum, 8th edition, 2018, William F. Armstrong, Thomas Ryan. 2. Textbook of Clinical Echocardiography: Book by Catherine Otto, 7th Edition 3. Textbook of Interventional Cardiology-8E Hardcover – 12 November 2019, Eric J Topol 4. Kern's Cardiac Catheterization Handbook: 7th Edition Paperback – Illustrated, 12 December 2019, Paul Sorojja. 5. Manual of Cardiovascular Medicine, November 2018, Brian P Griffin

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Cardiac Assist Device**
Course Code	**CVT3406**
Academic Year	Third
Semester	VI
Number of Credits	3
Course Prerequisite	Basic knowledge on cardiac failure mechanism and management
Course Synopsis	This course explores recent advances in cardiac imaging with a focus on heart failure, including types and management strategies such as Intra-aortic Balloon Pump (IABP), Cardiac Resynchronization Therapy (CRT), Ventricular Assist Devices (VAD), and Extracorporeal Membrane Oxygenation (ECMO). By the end of the course, students will gain insights into these advanced therapies and their applications in clinical practice

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Understand the principles of cardiac assist devices and their role in managing heart failure (C1)
CO2	Identify different types of cardiac assist devices and their applications in clinical practice (C2)
CO3	Evaluate the indications and contraindications for using cardiac assist devices in patients with heart failure (C2)
CO4	Analyse the physiological effects of cardiac assist devices on the cardiovascular system (C2)

Mapping of Course Outcomes (Cos) to Program Outcomes (Pos):

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x						x	
CO3	x						x	
CO4	x						x	

Course Content and Outcomes

Content	**Competencies**	**Number of Hours**
Unit 1		
Heart failure	• To understand the burden of heart failure and its consequences (C2) • To understand the complications associated with heart failure and prognosis (C3)	6

Content	Competencies	Number of Hours
Unit 2		
Types of heart failure	• To understand heart failure with reduced and preserved heart failure (C2) • Explaining the various cause for systolic and diastolic heart failure (C1) • To understand congestive heart failure (C3) • To explain various causes for heart failure and their management (C3)	8
Unit 3		
Intra-aortic Balloon Pump (IABP)	• To know the various indication for IABP (C1) • To know about the IABP instrumentation and techniques(C1) • To understand the concepts of supporting left ventricular function i.e systolic unloading of pressure and diastolic augmentation of pressure (C3) • To understand the positioning IABP in aorta and apply different operational modes present in the dashboard of IABP machine along with interpretation of waveforms (C4) • To evaluate and manage the complications of IABP implantation (C3)	8
Unit 4		
Cardiac resynchronization therapy (CRT)	• To understand mechanism and brief pathophysiology of intraventricular dyssynchrony(C2) • To explain indications for CRT (C2) • To understand brief procedure, lead placement, programming (C3) • Understanding Long term effects of CRT, Follow up assessment and identifying responders and non- responders(C3)	8
Unit 5		
Ventricular assist devices (VAD)	• Understanding the instrumentation, procedure, physiology of various VAD (C2) • Explaining the bridge to device, bridge to transplant and bridge to recovery VAD implantation scenarios (C2) • Understanding the duration of use specific to type of VAD and complications (C2)	7
Unit 6		
Extra corporeal membrane	• Understanding the instrumentation, procedure, physiology of various forms of ECMO (C2)	8

Content	Competencies	Number of Hours
oxygenation (ECMO)	• Explaining the veno arterial(V-A) ECMO, veno venous(V-V) ECMO(C2) • Understanding the duration of use specific to type of ECMO and their complications (C2)	
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement				
Learning Strategies	**Contact Hours**		**Out of class engagement**	
Lecture	30		-	
Seminar	5		-	
Assignments	5		-	
Revision	4		-	
Assessment	1		-	
Total	**45**		**45**	
Assessment Methods:				
Formative:	**Summative:**			
Assignments/Presentations	Mid Semester			
	End semester examination			
Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester exam	x	x	-	-
Assignments/Presentations	-	-	x	x
End Semester examination	x	x	x	x
Feedback Process:	End-Semester Feedback			
Main Reference:	• Joanna Chikwe, Emma Bedow, Brian Glenville (2006) Oxford Specialist Handbooks in Surgery – Cardiothoracic Surgery: . Oxford University Press, UK. January 2006. ISBN 0-19-856588-7. • Brian P. Griffin (2018) Manual Of Cardiovascular Medicine 5th edition.			

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Imaging Modalities in Cardiac Diagnosis**
Course Code	**CVT3407**
Academic Year	Third
Semester	VI
Number of Credits	3
Course Prerequisite	Basic knowledge on imaging techniques during cardiac catheterization
Course Synopsis	This course explores essential imaging modalities for cardiac diagnosis, including Intravascular Ultrasound (IVUS), Fractional Flow Reserve (FFR), and Optical Coherence Tomography (OCT) and it emphasizes their clinical utility and integration into cardiac diagnostic protocols. By the end of the course students will gain insights into the principles, applications, and roles of these advanced techniques in assessing coronary artery disease

Course Outcomes (COs):
At the end of the course student shall be able to:

CO1	Identify the indications for using different imaging modalities in the diagnosis of various cardiac conditions, such as coronary artery disease, valvular heart disease, and cardiomyopathies (C1)
CO2	Recognize the contraindications and safety considerations associated with different cardiac imaging modalities, including contrast agents and radiation exposure (C2)
CO3	Interpret cardiac imaging studies accurately, including recognizing normal and abnormal findings and understanding their clinical significance (C2)
CO4	Evaluate the role of advanced imaging techniques, such as 3D echocardiography, cardiac MRI with tissue characterization, and CT coronary angiography, in specific clinical scenarios (C2)

Mapping of Course Outcomes (Cos) to Program Outcomes (Pos):

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	x						x	
CO2	x						x	
CO3	x						x	
CO4	x						x	

Course Content and Outcomes

Content	Competencies	Number of Hours
Unit 1		
Intra vascular ultrasound	• Explaining the ultrasound principles(C2) • Identification and classification of atherosclerotic plaques: soft plaque, fibrotic plaque, calcific plaque, vulnerable plaque, mixed plaque and thrombus and its characteristics (C2) • Define and explaining the basic measurements, perivascular landmarks, stents and instents restenosis(C2) • Identification of artifacts(C2) • Explaining the safety of IVUS(C2) • To understand the branching patterns in the LAD and perivascular landmarks(C3) • To understand the stented/non-stented artery and artefact assessment(C3) • To know the relative contraindications(C1) • Explaining the potential uses of IVUS(C2) • To understand IVUS guided stent placement(C3) • To understand the virtual histology:IVUS based virtual coronary artery histology(C3) • Explaining aneurysm assessment: true/false aneurysm(C2)	11
Unit 2		
Fractional flow reserve	• To know the indications Contraindications(C1) • To know the Hardware's, technical aspects, Operating system and Handling of equipment(C1) • To understand the procedural assessment, Post procedural assessment, Reporting , Complications and it's management(C3)	11
Unit 3		
Resting full cycle flow ratio	• To know the indications Contraindications(C1) • To know the Hardware's, technical aspects, Operating system and Handling of equipment(C1) • To understand the procedural assessment, Post procedural assessment, Reporting , Complications and it's management(C3)	11
Unit 4		
Optical coherence tomography	• To know the indications Contraindications(C1) • To know the Hardware's, technical aspects,	12

	Operating system and Handling of equipment(C1) • To understand the procedural assessment, Post procedural assessment, Reporting , Complications and it's management(C3)	
	Total	**45**

Learning Strategies, Contact Hours and Out of class engagement		
Learning Strategies	**Contact Hours**	**Out of class engagement**
Lecture	30	-
Seminar	5	-
Assignments	5	-
Revision	4	-
Assessment	1	-
Total	**45**	**45**

Assessment Methods:	
Formative:	**Summative:**
Assignments/Presentations	Mid Semester
	End semester examination

Mapping of Assessment with COs:				
Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Mid Semester / Sessional Examination 1	x	x	-	-
Assignments/Presentations	-	-	x	x
End semester examination	x	x	x	x

Feedback Process:	End-Semester Feedback
Main Reference:	• Grossman & Baim's Cardiac Catheterization, Angiography, and Intervention (SAE) 9th Edition • Morton J. Kern, Paul Sorajja, Cardiac Catheterization Handbook • Brian P. Griffin (2018) Manual Of Cardiovascular Medicine 5th edition.

SEMESTER VII & Semester VIII

INTERNSHIP PROGRAM

Manipal College of Health Professions	
Name of the Department	Cardiovascular Technology (CVT)
Name of the Program	Bachelor of Science in Cardiovascular Technology
Course Title	**Internship**
Academic Year	Fourth Year
Semester	VII & VIII
Course Prerequisite	Student should have complete knowledge on interpretation and reporting of ECG, TMT and Holter, to self-diagnose and report by performing echocardiographic test, to analyze and report pacemaker programming and to possess knowledge on hardware and equipment's used during the assistance of cardiac interventional procedures
Course Synopsis	During internship, students will get the necessary hands on exposure to all the professional aspects pertaining to cardiovascular technological practice. The training centres can be internal (MAHE) or external. The external organisation will be chosen based on the quality of clinical exposure facility. Students are expected to spend their training in various specialities such as non-invasive cardiac diagnostic areas like ECG, TMT, Holter, Pacemaker Analysis and Echocardiographic room also attending bedside, ICUs and emergency call duties and invasive areas like cardiac interventional suit in order to assist the planned and emergency procedures. Clinical competency of the interns will be assessed continuously. Comprehensive clinical logbook and detailed clinical portfolio will be maintained and evaluated.
Course Outcomes (COs): **At the end of the internship student shall be able to:**	
CO1	Build skills to perform ECG and develop practical knowledge and ability to interpret and report any given ECG (P5)
CO2	Perform and able to analyse ambulatory ECG recording (HOLTER) as well as evaluation of HOLTER monitoring (P4, A2)
CO3	Perform and able to analyse TMT as well as evaluation and reporting (P4, A2)
CO4	Perform and able to analyse and program in pacemaker implanted patients (P4, A3)
CO5	Perform echocardiographic examination, to interpret and report in the evaluation of cardiovascular diseases (P5, A3)
CO6	Handel and co-ordinate task with the operating team with appropriate knowledge on the procedure attending in cardiac interventional suit (P5, A2)

Mapping of Course Outcomes (COs) to Program Outcomes (POs):								
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1		x				x		
CO2	x	x						
CO3	x	x			x			
CO4		x	x				x	
CO5		x						x
CO6		x	x			x		

Course Content and Outcomes:

Area 1 : Electrocardiogram non-invasive practice

- To set the practice area for daily activities (P2)
- Able to place leads and perform ECG and to report (P4)
- Build skills to develop practical knowledge and ability to interpret and report any given ECG (P4)
- To report ECGs online which is receive from outside clinical centres under the supervision of the faculty (P4)

Area 2 : Tread mill non-invasive practice

- Should know the standard protocol of performing TMT and use of emergency drugs (P2)
- To know the operations of TMT machine and programmed computers with different protocol and procedures (P4, A2)
- To clinically correlate patient's symptoms, history with ECG and to perform TMT under the supervision (P4, A2)
- To analyse the test results and compare it with the baseline findings and report (P4, A2)
- To Know the termination indication, complication and its management of TMT (P4, A2)
- To build knowledge in TMT interpretation and discuss on the management (P4, A2)
- Should develop technical skills in patient rescue during emergency (P4, A2)

Area 3 : Holter analysis practice

- Should know to utilize different methods of lead placement in recording ambulatory ECG (P4, A2)
- Able to analyse and interpret stored ECG data (P4, A2)

Area 4 : Pacemaker and Device analysis practice

- Should classify the type of pacemaker based on the ECG recording and functioning of the device (P2, A2)
- To know the operations of pacemaker programmer/analyser with different protocols various various devices (P4, A2)
- Able to assess the parameters and their importance during analysis (P4, A2)
- To perform pacemaker analysis under the supervision of a staff/faculty (P5, A3)
- To add findings based on analysis and document in the patient file (P4, A3)
- To diagnose pacemaker related problems and tackle in troubleshooting (P7, A3)

Area 5 : Echocardiography non-invasive practice at OPD

- To set the practice area for daily activities (P2)
- To know the basic principle of ultrasound (P4, A2)
- To know the operations of echo machine, entry of patient details, to record and save images (P4, A2)
- To document the patient details before performing echo in register books (P4, A2)
- To explain the patient and prepare them for the test (P4, A2)
- To perform the test and diagnose the normal and abnormal heart diseases under the guidance/supervision of faculty (P4, A2)
- To provide written report and document it, in the online system and excel data for further reference and clarification (P4, A2)

Area 6 : Bedside Echocardiography non-invasive practice at ICUs

- To take all necessary equipment's along with the echo machine and handle it carefully (P4, A2)
- To document the patient details before performing echo (P4, A2)
- To perform the test and diagnose the normal and abnormal heart diseases under the guidance/supervision of faculty (P4, A2)

Course Content and Outcomes:

- To provide written report and document it (P4, A2)
- To report to the concerned physician in care of clinical emergency or life threatening situations (P4, A2)
- To report the work done at the end of duty hours to the duty faculty in the presence of next shift duty interns in order to update the cases handled (P4, A2)

Area 7 : Bedside Echocardiography non-invasive practice at Emergency Triage

- To take all necessary equipment's along with the echo machine and handle it carefully (P4, A2)
- To document the patient details before performing echo (P4, A2)
- To perform the test and diagnose the normal and abnormal heart diseases under the guidance/supervision of faculty (P4, A2)
- To provide written report and document it (P4, A2)
- To report to the concerned physician in care of clinical emergency or life threatening situations (P4, A2)
- To report the work done at the end of duty hours to the duty faculty in the presence of next shift duty interns in order to update the cases handled (P4, A2)

Area 8 : Bedside Echocardiography non-invasive practice at peripheries

- To take all necessary equipment's along with the echo machine and handle it carefully (P4, A2)
- To document the patient details before performing echo (P4, A2)
- To perform the test and diagnose the normal and abnormal heart diseases under the guidance/supervision of faculty (P4, A2)
- To provide written report and document it (P4, A2)
- To report to the concerned physician in care of clinical emergency or life threatening situations (P4, A2)
- To report the work done at the end of duty hours to the duty faculty in the presence of next shift duty interns in order to update the cases handled (P4, A2)

Area 9 : Invasive Cardiac Interventional Suit (Cath Lab) Practices

- To set the practice area for daily activities (P2)
- To check and keep the required hardware for the elective and emergency procedures (P6, A2)
- To obtain informed consent from Patient and their bystander (P3, A2)
- To develop skills in Cath lab equipment (operating table) handling under supervision of staff/ faculty (P5, A2)
- To actively involve in the procedure and assist the interventional team (P6, A2)
- To document the items used for the procedure in register book as well as patients file (P5, A4)
- To apply BLS/ACLS skills whenever necessary (P5, A4)
- To know post procedural care (removal of sheath/ compression) (P5, A4)
- To know the operating systems of FFR, IVUS, OCT, ROTA, IABP, TPI, PPI, Defibrillators (P5, A4)

Area 10 : Clinical Ward Rounds

- Should be able to evaluate patient based on the case history (P2, A1)
- Ability to perform basic patient examination steps (P4, A2)
- Should perform tasks or activity under the supervision of physician (P4, A3)
- Should make an evaluation of a given case based on the routine investigations (P5, A4)

Project Work:

A project work to be completed on topic related to Cardiology, under the guidance of the HOD and Faculties (C4, A4)

Course Content and Outcomes:

- The assigned study has to be approved by institutional ethical committee (IEC) and a CRTI registration to be done if applicable (C3, A4)
- Appropriate literature survey to be done and reported in the study (C5, A4)
- Collection of Study data and sample size to be done within the stipulated time given for the study (C5, A4)
- A written Thesis to be submitted reporting the study results and observations (C6, A4)

Learning Strategies: Small group discussion (SGD), Problem Based Learning (PBL), Case Based Learning (CBL), Clinics, Seminars. **Formative Assessment:**

- Quiz, Viva, Clinical assessment (OSCE, OSPE, WBPA), Clinical Log Book, Interns work dairy
- The Interns should present at least 10 academic presentations on topic related to the programme before completing the internship which will be added to the assessment, the topic for presentation will be given to the Intern by the HOD/In-charge faculty
- Interns will be evaluated periodically i.e. in every quarter of 12 months and aggregate marks of all four assessments will be used to issue internship completion certificate.
- Internship completion certificate will be issued from Dean's office, only after successfully clearing all four assessment exams and obtaining satisfactory completion certificate from the head/ In-charge of the department at the end of internship.

7. Program Outcomes (POs) and Course Outcomes (COs) Mapping

SEM	Course Code	Course Title	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
I	ANA1301	Anatomy - I	3	CO1 CO2 CO3 CO4							
I	PHY1301	Physiology - I	2	CO1 CO2 CO3 CO4							
I	CSK1501	Communication Skills	2		CO3	CO4		CO1 CO2		CO1 CO2 CO3 CO4	
I	EIC1501	Environmental Science	2	CO1 CO2 CO3		CO4 CO5	CO2		CO1 CO3 CO5	CO4	
		Indian Constitution		CO1		CO3	CO2 CO5	CO2	CO4	CO1 CO3 CO5	CO4
I	CVT1301	Cardiac anatomy and physiology	2	CO1 CO2 CO3 CO4							
I	CVT1302	Basic ECG	3	CO1 CO2 CO3 CO4						CO4	
I	CVT1303	Cardiac Embryology	3	CO1 CO2 CO3 CO4							
I	CVT1304	Clinics I	3		CO1 CO2 CO3 CO4	CO1		CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4	CO4	
II	ANA1401	Anatomy - II	2	CO1 CO2 CO3 CO4							
II	PHY1401	Physiology - II	2	CO1 CO2 CO3 CO4							
II	BIC1401	Biochemistry	3	CO1 CO2 CO3 CO4							
II	CVT1401	Advance ECG and Holter Monitoring	4	CO1 CO2 CO3 CO4					CO1 CO2 CO3 CO4		

SEM	Course Code	Course Title	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
II	CVT1402	Medical Ethics & legal Aspects	2			CO3 CO4	CO1 CO2 CO3 CO4	CO2 CO3		CO1 CO3	CO4
II	CVT1403	ECG interpretation, Holter Analysis Practicals	4		CO1 CO2 CO3 CO4			CO2	CO1 CO3 CO4	CO3	CO3
II	CVT1404	Clinics II	3	CO1 CO2	CO1 CO2 CO3 CO4					CO3 CO4	
II	MCB2303	Microbiology	3	CO1 CO2 CO3 CO4							
II	PAT2303	Pathology	3	CO1 CO2 CO3 CO4							
III	CVT2301	Ultrasound Physics and Doppler Principles	3	CO1 CO2 CO3 CO4					CO2 CO3	CO1 CO2 CO3 CO4	
III	CVT2302	Cardiac Stress Test	3	CO1 CO2 CO3 CO4	CO1	CO2 CO3 CO4	CO1 CO2	CO2	CO3 CO4	CO1 CO2 CO3 CO4	
III	CVT2303	Cardiac Instrumentation	2	CO1 CO2 CO3 CO4							
III	CVT2304	Clinics - III	3		CO1 CO2 CO3 CO4	CO1 CO2 CO3 CO4	CO1		CO3 CO4	CO3 CO4	
III	*** ****	Open Elective - I	3	*Open elective is credited, choice-based and is graded as satisfactory / not satisfactory (S/NS). Students make a choice from pool of electives offered by MAHE institution / Online courses as approved by the department*							
IV	PHC2403	Pharmacology	3	CO1 CO2 CO3 CO4							
IV	CPY2401	Clinical Psychology	3	CO1 CO2 CO3 CO4	CO4				CO1	CO2 CO3	
IV	BST3401	Biostatistics and Research Methodology	3	CO1 CO2 CO3 CO4			CO3 CO4	CO3 CO4	CO1 CO2	CO1 CO2 CO3 CO4	

SEM	Course Code	Course Title	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
IV	CVT2401	Basics of Cardiac Implantable Electronic Devices	2	CO1 CO2 CO3 CO4			CO3 CO4	CO3 CO4	CO1 CO2	CO1 CO2 CO3 CO4	
IV	CVT2402	Congenital Heart Disease I	4	CO1 CO2 CO3 CO4		CO1	CO4	CO2 CO3	CO1 CO2 CO3 CO4		
IV	CVT2403	Clinics IV	2		CO1 CO2 CO3 CO4	CO3 CO4	CO1		CO2		
IV	CVT2404	Cardiac Interventional Hardwares	3	CO1 CO2 CO4		CO2 CO3	CO3				
IV	CVT2405	Analysis of Cardiac Implantable Electronic Devices	3	CO1 CO3 CO4	CO1 CO2 CO3 CO4	CO3 CO4	CO3				
V	CVT3301	Basics In Cardiac Cath and Hardwares	4	CO1 CO2 CO3 CO4	CO1 CO2 CO3	CO2	CO1 CO2	CO2	CO3 CO4	CO1	
V	CVT3302	Miscellaneous cardiovascular diseases	3	CO1 CO2 CO3 CO4		CO3			CO4	CO2 CO3 CO4	
V	CVT3303	Congenital Heart Disease - II	3	CO1 CO2 CO3		CO2	CO2		CO3	CO1	
V	CVT3304	Valvular Heart Disease	3	CO1 CO2 CO3 CO4		CO4			CO2 CO3		
V	CVT3305	Clinics - V	4		CO1 CO2 CO3 CO4	CO2 CO3	CO2	CO3	CO3	CO1 CO4	CO4
V	*** ****	Open Elective - II	3	*Open elective is credited, choice-based and is graded as satisfactory / not satisfactory (S/NS). Students make a choice from pool of electives offered by MAHE institution / Online courses as approved by the department*							
VI	CVT3401	Applications of Echocardiography	4	CO1 CO2 CO3 CO4					CO3 CO4	CO1 CO2 CO3 CO4	CO3 CO4
VI	CVT3402	Cardiac Cath and Intervention	4	CO1 CO2 CO3 CO4		CO2 CO3	CO2 CO3	CO4	CO4	CO1 CO4	
VI	CVT3403	General Cardiac Examination and BLS-ACLS	3	CO1 CO2 CO3 CO4	CO4	CO2	CO2 CO4	CO4	CO3	CO1 CO4	

SEM	Course Code	Course Title	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
VI	CVT3405	Practicals in Cardiac Cath and Imaging	3	CO1 CO4	CO1 CO2 CO3	CO2 CO3	CO2 CO3		CO3	CO1 CO3	
VI	CVT3232	Clinics - VI	3		CO1 CO2 CO3 CO4	CO2 CO3	CO2	CO3	CO3	CO1 CO4	CO4
VI	CVT3406	Cardiac Assist Devices	3	CO1 CO2 CO3 CO4						CO1 CO2 CO3 CO4	
VI	CVT3407	Imagining Modalities in Cardiac Diagnosis	3	CO1 CO2 CO3 CO4						CO1 CO2 CO3 CO4	
VII & VIII		Internship	1 year	CO2 CO3	CO1 CO2 CO3 CO4 CO5 CO6	CO4 CO6		CO3	CO1 CO6	CO4	CO5

8. UG Program regulation

1. Program Structure

1.1. The program is a choice based credit system.
1.2. An academic year consists of two semesters – Odd semester (July - December) and Even semester (January – June).
1.3. Each semester shall extend over a minimum period of 16 weeks of academic delivery excluding examination days, semester breaks, declared holidays and extracurricular events.
1.4. Medium of instruction shall be in English

2. Credit Distribution

2.1 Each semester would consist minimum of 20 credits.
2.2 The credit distribution hours for Lecture, Tutorial, Practical, and Clinics are as follows:
Lecture / Tutorial: 1 credit = 15 hrs
Practical: 1 credit = 30 hours
Clinical: 1 credit = 45 hours

2.3 A semester has courses structured as theory, practical, laboratory and clinics. Each course is of minimum 2 credits.
2.5 Internship duration is as per the course regulation.
2.6 Abbreviations / Symbols used in the credit distribution table:
L - Lectures, T - Tutorials, P -Practical, CL - Clinics, C - Total credits, IAC - Internal assessment component, ESE - End-Semester Exam, *Open Elective, #Program Elective

3. Weightage for Internal Assessment Component (IAC) and End Semester Exam (ESE)

3.1. Any one or a combination of marks distribution criteria applicable to a course

Program	IAC Weightage (%)	ESE Weightage (%)
RCI Approved Programs	20	80
	25	75
	50	50
	100	Nil
	Nil	100
Other Programs	30	70
	50	50
	100	Nil

3.2 The IAC component weightage for theory & practical is:
- 50% from Mid-semester examination
- 50% through Continuous assessment (as applicable to course)

3.3 For courses without continuous evaluation components, two sessional exams are conducted and the average of both sessional exams shall be considered as the final IAC.

4. Attendance

4.1 Minimum attendance requirements for each course is:

i. Theory : 75 %
ii. Clinics / Practical : 85 %

4.2 As per the directives of MAHE, the deemed to be university, there will be no consideration for leave on medical grounds. The student will have to adjust the same in the minimum prescribed attendance. No leverage will be given by the department / institution for any attendance shortage.

4.3 Students requiring leave during the academic session should apply for the same through a formal application to the Head of Department through their respective Class In-charge/ Coordinator. The leave will be considered as absent and reflected in their attendance requirements.

4.4 Students, Parents/ guardians can access the attendance status online (Student Life Cycle Management) periodically.

4.5 Students having attendance shortage in any course (theory & practical) will not be permitted to appear for the End-semester exam (ESE) of the respective course unless the attendance is compensated as per the institutional guidelines.

5. Evaluation / Examination

5.1 The final evaluation for each course shall be based on Internal Assessment Component (IAC) and the End-semester examination (ESE) as per the weightage indicated for respective courses.

5.2 Internal Assessment Component (IAC) shall be calculated based on the performance of the student in mid semester exam or sessional exam/s, and continuous assessment (class participation, assignments, seminars or any other component as applicable to a course).

5.3 For courses such as Communication skills, Open electives, Indian constitution, Environmental sciences or courses as specified in curriculum of respective program, only internal assessment is conducted.

5.4 At the end of each semester, a regular End Semester Examination (ESE) for the odd and even semesters will be conducted in November-December/ May-June cycle respectively.

5.5 A one week of preparatory leave will be given to students before they appear for the regular end semester examination.

5.6 A student should obtain minimum of 40% Internal Assessment Component (IA) to be eligible for End Semester Examination. Failure to secure 40%, he/she will be not appearing for the regular End Semester Examination (ESE). However, he/she will be permitted to write during the supplementary exam as per institutional guidelines.

5.7 The duration of End Semester Examination for a 2 credit course would be 2 hours (50 marks) and for a course with 3 or more credits, 3 hours (100 marks).

5.8 For pre / para clinical course and program elective, irrespective of credit (2 or 3), the ESE is conducted out of 50 and normalized to 100 including internal assessment.

5.9 For those students who failed to earn credit for a course during regular End Semester Examination, an additional supplementary / make up exam is conducted within 2 weeks of declaration of end semester result.

5.10 In order to facilitate for improvement of Internal assessment for failed candidates, an internal assessment exam will be conducted immediately after the declaration of end semester (ESE) results. This examination will be conducted as per the university guidelines.

5.11 A regular student is eligible to appear for two attempts per cycle of each semester (End semester and supplementary exams).

5.12 For a student who has completed the mandated academic requirements / final year, but has pending courses from any of semesters, he / she can take the examination of courses irrespective of odd / even exam cycle. The additional odd / even semester exam as applicable is scheduled between the regular and supplementary exam.

6. Minimum Requirements for Pass

6.1 A ten (10) point grading system **(credit value)** is used for awarding a letter grade in each course.

Letter Grade	A+	A	B	C	D	E	F/I/DT
Grade points	10	9	8	7	6	5	0

DT – Detained/Attendance shortage, I – Incomplete

6.2. A pass in a ESE will be reflected as grades. Candidate shall be declared to have passed in any course, when he/she obtains not less than **"E" grade.**

6.3 However, when a student appears for supplementary examination, the maximum grade awarded is **"C" grade** or below irrespective of their performance.

6.4. **Pass criteria for courses with End Semester Examination:** For theory / practical course, a candidate should secure a minimum of 40% in ESE and an overall 50% including IAC to be declared as pass.

6.5. **Pass criteria for courses with Internal Assessment Component:** The students should obtain 50% IAC to be declared as pass in a given semester.

7. Calculation of GPA and CGPA

7.1. Evaluation and Grading (**Relative Grading**) of students shall be based on GPA (Grade Point Average) & CGPA (Cumulative Grade Point Average).

7.2. The overall performance of a student in each semester is indicated by the Grade Point Average (GPA). The overall performance of the student for the entire program is indicated by the Cumulative Grade Point Average (CGPA).

7.3. A ten (10) point grading system **(credit value)** is used for awarding a letter grade in each course.

Letter Grade	A+	A	B	C	D	E	F/I/DT
Grade points	10	9	8	7	6	5	0

DT – Detained/Attendance shortage, I – Incomplete

7.4 Calculation of GPA & CGPA: An example is provided

Course code	Course	Credits (a)	Grade obtained by the student	Credit value (b)	Grade Points (a x b)
AHS 101	Course - 1	4	B	8	32
AHS 103	Course - 2	4	B	8	32
AHS 105	Course - 3	3	A+	10	30
AHS 107	Course - 4	4	C	7	28
AHS 109	Course - 5	5	A	9	45
	TOTAL	**20**	**-**	**-**	**167**

1st Semester GPA = Total grade points / total credits
167/20 = **8.35**

Suppose in **2nd semester GPA** = **7** with respective course credit 25

Then, $\textbf{1st Year CGPA} = \frac{(8.35 \text{ x } 20) \ + \ (7 \text{ x } 25)}{20 \ + \ 25} = 7.6$

8. Carry over rule / Progression Criteria to higher semesters

The eligibility for promotion to the next academic year is subject to securing the minimum academic performance as specified below:

8.1. First to second year (progression to third semester): A minimum of 65% of the credits at the end of the first year (includes first and second semester credits)

8.2. Second to third year (progression to fifth semester): A cumulative minimum of 75% of the credits at the end of the second year (includes first, second, third and fourth semester credits)

8.3. Third year to fourth year (progression to seventh semester), applicable for 4½ year programs – BPT, BOT, BPO: A cumulative minimum of 85% of the credits at the end of the third year (includes first, second, third, fourth, fifth and sixth semester credits).

8.4. Student will be eligible for internship only after successful completion of the entire course work, i.e. earn 100% credits of the program

9. Program Exit / Probation Criteria

9.1 First year students who have failed to secure a minimum credit (as specified in progression criteria / carry over rule section), will be on **probation for next one year.** During that period, he / she will not be permitted to attend the second year / III semester classes and have to appear only for examination of the respective examination cycle only (during December / May) in order to acquire the credits for promotion to higher semester. In the event of failure to acquire the required credits even by the end of second year (65%), he / she has to **exit the program**. This exit policy from the program is applicable only for first year students failing to acquire the required credits even after the probation period.

9.2 From second year onwards, in the event of failing to acquire required credits (75% or 85% of the respective year), the students will be on academic probation. During that period, he / she will not be permitted to attend the classes of higher semester and have to appear only for examination (during December / May) of the failed courses in order to acquire the required

credits for progression. From second year onwards, even though a student has failed to acquire the minimum credits, he/she will not be required to exit from program.

9.3 However, the student must complete all the course work requirements and credits by a **maximum of double the program duration**.

9.3.1 For the program duration of 3+1 years' program, all the academic course work needs to be completed within the duration of 8 years.

9.3.2 For the program duration of 4 years 6 months' program, all the academic course work needs to be completed within the duration of 9 years.

10. Semester Break

10.1 Students will have a semester break following their odd and even end-semester examinations as per the academic calendar.

11. Internship

11.1 Internship will be for a duration of 6 months or 1 year as per the respective program regulation

11.2 Any components/ activities that need to be evaluated as part of internship without reflecting it in the CGPA.

11.3 The intern should abide by the rules and regulations of the organization during the period of internship.

11.4 An internship certificate with details of activities (including externship), clinical /relevant areas of postings with hours and research project will be issued to a candidate on completion of the Internship. The certificate must be authenticated by the HOD/Coordinator and HOI.

11.5 **Degree is awarded** only on successful completion of internship.

Head of the Department **Dean**

Deputy Registrar - Academics **Registrar**