

Bachelor Degree in Cardiovascular Technology (BCVT)

Introduction:

Cardiovascular Technologist assists cardiologists with invasive and noninvasive diagnostic and therapeutic interventional procedures. Catheterization involves inserting a small tube, known as a catheter, into a patient's blood vessel and then into the heart. The procedure is done to determine whether the patient has a blood vessel blockage or heart disease. The procedure also involves balloon angioplasty, valvoplasmy, closure of congenital defects, pacemaker implantation, vascular diagnosis and interventions etc.

Cardiovascular technologists prepare patients for invasive heart procedures, monitor the patients' blood pressure and heart rate with ECG equipment, notify the cardiologist immediately of any changes in the patients' condition as well as assist the cardiologist during the procedures. Moreover, they can perform noninvasive diagnostic procedures like echocardiography, Holter and treadmill exercise testing under supervision

It goes without saying that cardiovascular technologists hold an important role in the diagnostic and interventional procedures in cardiology. There is increasing need for these personnel as the number of cardiac centers and investigative facilities is increasing in the state by leaps and bounds. Unlike most other disciplines in medicine where these technologists help the doctors in diagnostic procedures only, cardiovascular technologists assist in invasive procedures and meet with life and death situations. So; they have to be trained more rigorously and need to be more mature in their approach, because mistakes may cost lives. Hence the course has to be at least 3 years with a year of internship. The course has to be a bachelor degree course.

Detailed Curriculum:

I. General Information:

- a) Name of the course – **Bachelor Degree in Cardiovascular Technology (BCVT)**
- b) Objective:

To train the student to assist *the* cardiologist in invasive or non invasive cardiac laboratory, in performing routine cardiac investigations and interventional procedures.

- a. **Scope:** After successful completion of the course, the person can be allowed to perform noninvasive procedures like echocardiography, treadmill and Holter testing under supervision of cardiologist and assist the cardiologist in cardiac catheterization laboratory.

c) Eligibility for admission:

a. **Minimum educational qualification**

- i. ***Plus Two or equivalent with Biology, Physics and Chemistry with at least 50% aggregate marks in the above subjects in the qualifying examination***
- ii. ***Nativity - Indian citizens of Kerala origin*** are eligible for admission
- iii. ***Age limit*** The candidate should have completed 17 years of age at the time of admission. Upper age limit is 22 years. A relaxation of 3 years in the upper age limit may be allowed for students belonging to SC/ST category.

d) **Method of selection:**

Eligible candidates will be selected based on merit assessed by computing **total marks scored in the science subjects** by the candidates in the qualifying examination. If there is tie, the mark scored in English for Plus Two/ Higher secondary will be computed

e) **Maximum Number of seats:** ***Not to exceed 4 per batch per institution. The number of seats that can be approved should be based on the minimum requirements as in appendix I***

f) **Reservation of seats:** As per existing Government guidelines.

II. Course Content:

a) Duration of the course and structure: ***Three years plus one year of compulsory rotating internship.*** Apart from Sunday off and Government holidays, one month vacation may be allowed after each year. Detailed syllabus in Appendix II

b) Instructional Period:

1st year , IInd year and IIIrd year - 1 hour lecture and 5 hours practical training per day

A minimum of three months posting during final year in any reputed institution should be arranged for each student for training in advanced procedures like electrophysiology and other interventional procedures, if these procedures are not performed in the institution concerned

c) What is expected of the student at the end of the course:

Candidate should have acquired basic and applied knowledge in cardiovascular diagnostic and therapeutic procedures.

d) Requirements for satisfying completion of the subject study:

- a. Minimum 80% attendance in theory and practical separately
- b. Submit records (log book), duly certified every week by the faculty in charge.
- c. Progress evaluated continuously through internal assessment

- d. Certificate of satisfactory completion of the course by the Head of department

g) Duration of Posting of trainees in different stations during training period

Posting station	First year	Second year	Third year
Echocardiography	4 months	4 months	4 months
ECG, Stress Testing, Holter	4 months	2 months	2 months
Catheterization laboratory	4 months	6 months	6 months

III. Evaluation:

Internal Assessment:

Scheme of assessing the progress during the course of study: Through internal assessment by written test conducted by the Cardiology Department at the end of first year and second year. Marks obtained in internal assessment will be included in the theory marks at the final examination.

Final Examination – Authority to conduct the exam – DME / University

a) Scheme of Final Examination:

At the end of third year regular examination will be conducted for all the subjects in the following pattern.

The examination will comprise of written examination, practical/viva voce

i) Theory:

Internal Assessment : 100 marks

Final exam

Number of papers : 3

Duration of written exam : 2 hours each

Maximum marks : 100 marks per paper

Total : **400 marks**

ii) Practical /Viva voce

Duration : 1 hour

Maximum marks : **100 marks** (75 for practical/viva voce and 25 for records)

Grand Total : 500 marks

Criteria for a pass in the subject

- i) Minimum aggregate marks in theory : 50%
- ii) Minimum marks in practical and viva voce together : 50%

Awarding 1st Class and Rank:

- Candidates scoring 66% or above will be awarded 1st Class
- Candidates scoring 75% or above will be awarded Distinction
- Candidates who scores highest marks in the aggregate of theory and practical + viva voce will be awarded 1st Rank at the end of the course.

Supplementary Examination

Students who fail in the regular examination can be appear for supplementary examination after 6 months. No additional instruction period is necessary to appear for the supplementary examination.

Eligibility criteria for appearing for the final examination: All of the following:

- i) Attendance – Minimum 80% in theory and practicals separately
- ii) Completed records in the subjects duly approved by the faculty concerned
- iii) Should have obtained minimum of 45% marks in the internal assessment
- iv) Should produce certificate of satisfactory completion of course from the Head of the Department conducting the course.

Question Paper:

Theory – 3 papers as follows

1. Basic sciences in relation to General anatomy, cardiac anatomy, physiology, pathology and pathophysiology, microbiology and pharmacology
2. Principles and practice of electrocardiography (including stress testing and Holter recording) and echocardiography

Practical –and viva voce- performance of procedures, spotters and viva

Examiners:

Qualification – Minimum D.M. or DNB Cardiology with minimum 5 years experience

Number of examiners – 2 - One internal and one external

IV. Internship duration: One year, after successful completion and passing of the course. The internship will consist of compulsory rotating practical training in the various subjects duly certified by the Head of department. Maximum no. of leave will be 20 for the whole period. 1 day weekly off may be additionally permitted. No holidays. Sick leave may be permitted by the head of institution on production of bona fide medical certificate

V. Award of Degree: A provisional certificate of the Degree is awarded by the authority at completion of the course successfully and passing the final examination. Degree certificate is awarded after the successful completion of internship.

VI. Registration: The process of registration of successful candidates may be as directed by the Government

VII. Remuneration for the teachers and examiners:

Appropriate remuneration for the teachers and examiners on the basis of sessions of teaching and days of examinership should be provided for the smooth conduct of the course. The decision and the payment pattern should be evolved by the Government / University

Appendix I.

Minimum Requirements for the conduct of the course:

The course shall be conducted only in a well equipped hospital setting with a proper Department of Cardiology. The following are the minimum requirements for registration of the course

The following are the minimum requirements for admitting maximum 2 students for BCVT

The hospital shall have active and well functioning Cardiology and Cardio thoracic Surgery Department.

a Infrastructure

Library	Of minimum 30ft x 20ft. area and minimum of 20 books of related subjects including major journals in cardiology
Lecture Hall	1 number, 30 ft x 20ft.
Students room	Separate for boys and girls
Hostel	Separate for boys and girls
Office, Staff room, Toilet facilities for staff and students	

b **Equipments:** The following equipments should be available in good working condition in the Department

1. ECG machines sufficient no. of digital and analog single channel /6 or 12 channel with facility for bedside ECG
2. Modern automated treadmill machines
3. Holter analyzer with sufficient no' of recorders
4. Standard quality dedicated echocardiograph suitable for cardiac applications with adult, pediatric and transesophageal probes and facility for dobutamine stress echo and transesophageal echo
5. A modern cath lab consisting of:
 - a. Digital angiographic equipment with motorized gantry
 - b. Hemodynamic recorder,
 - c. Hemoximeter
 - d. Pressure injector
 - e. IABP
 - f. other necessary ancillary equipments for adult and pediatric studies

c. **Patients and procedures:**

1. Minimum bed strength for cardiology – 20
2. CCU with at least 4 beds with all modern amenities like invasive and noninvasive monitors and ventilators
3. Minimum ECG load of 2500 per year
4. Minimum number of treadmill tests 1000 per year
5. Minimum number of Holter testing 100 per year
6. Minimum number of echoes – 3000 per year which should include congenital, valvular and coronary heart diseases. TEE - 40 per year
7. Minimum number of cath lab procedures*
 - a. Coronary angiography – 600 per year
 - b. Coronary angioplasty – 120 per year
 - c. Balloon valvotomy – 20 per year
 - d. Electrophysiology – 20 per year
 - e. Closure of congenital cardiac defects – 20 per year
 - f. Diagnostic right and left heart catheterizations – 20 per year

*Departemnts which do not perform the procedures as specified may be permitted to register for the course but should send the candidates for 3 months training in any other reputed institution where such procedures are performed

b) *Minimum staff requirement*

i. For 2 seats per batch

Cardiologist	DM/DNB Cardiology with al least 5 years experience after the qualification	2
Instructors	1. Cath lab Technologist with ≥ 2 years experience 2. ECG Technicians	1 2
Administrative Officer	Graduate with experience administration for 3 years Degree/Diploma in Hospital Management preferred	1
Assistant	Graduate with computer knowledge	1

Note:

1. *The cardiologists should be full time and in the pay roll of the institution*

ii. For each additional seat

- one additional full time cardiologist with at least 3 years experience after qualification

APPENDIX II - BCVT SYLLABUS

Year	Subject	
I	Anatomy Gross Human Anatomy	General introduction to anatomy Organ systems in the Body with various parts
	Anatomy of Cardio vascular system	<p>Anatomy of Heart:</p> <ul style="list-style-type: none"> • Surface anatomy, • Gross anatomy, cardiac chambers, septa, valves, • Pericardium <p>Arteries, Veins, Lymphatics</p> <ul style="list-style-type: none"> • Aorta and branches • Venous drainage • Pulmonary vessels and circulation • Coronary circulation and coronary venous drainage <p>Conduction System of Heart</p>
	Physiology	<ul style="list-style-type: none"> • Normal Cardiac Cycle • Pulse • Heart rate • Blood pressure • Cardiac output • Heart Sounds, Murmurs • Measurement of Blood Pressure :Technique : Sphygmomanometer • ECG and Cardiac Cycle • Chambers: Pressures, Wave Forms • Arterial, Venous Pressures and Wave Forms • Oxygen Saturations: Physiology of Oxygen Transport • Blood Gases – Technique and Various parameters • Flow, pressure and resistance • Cardiac Cycle, Circulation, Tissue Perfusion – Unified Concept

APPENDIX II - BCVT SYLLABUS

	Pathology and Pathophysiology	<ul style="list-style-type: none"> • Coronary artery disease and myocardial infarction • Rheumatic Fever • Valvular Heart Disease <ul style="list-style-type: none"> ○ Mitral stenosis ○ Mitral regurgitation ○ Aortic stenosis ○ Aortic regurgitation ○ Tricuspid valve disease ○ Combined valve diseases • Pericardial, Myocardial Diseases including End myocardial Diseases • Hypertension • Pulmonary Hypertension • Congenital Heart Disease: <ul style="list-style-type: none"> ○ Acyanotic ○ Cyanotic • Shunts <ul style="list-style-type: none"> ○ Left to Right Shunts ○ Right to Left Shunts • Heart Failure • Invasive Monitoring, CVP, Intra Arterial BP, PA Wedge Pressure, Cardiac Output
	Microbiology	<ul style="list-style-type: none"> • Common microorganisms • Sepsis • Aseptic precautions • Sterilization procedures •
	Pharmacology and Therapeutics	<ul style="list-style-type: none"> • Modes / routes of Drug Administration (Rationale) • Intra Venous Fluids: Crystalloids, Colloids • Common Cardiac Drugs – PART-I: Digoxin, Diuretics, Vasodilators, Nitrates

APPENDIX II - BCVT SYLLABUS

		<ul style="list-style-type: none"> • Common Cardiac Drugs – PART-II: Beta Blockers, Calcium Blockers, ACE inhibitor • Common Cardiac Drugs – PART-III: Antiarrhythmic drugs, Positive inotropic drugs • Drugs for Cardiac Resuscitation • Drugs for all Cardiac and Medical Emergencies • Contrast Media • Heparin, Protamine • Anaphylaxis, Drug reactions, Drug interaction (Basics)
II	Electrocardiography	<ul style="list-style-type: none"> • Basics and Principle • Electrode / Lead Placements • Normal ECG: Wave Form • Normal ECG: Intervals • ECG Machines: Functions, Frequency Response, Recording Speed, Sensitivity, Standardisation, Stylus Lag (Heat Stylus) • ECG and Chamber Hypertrophy • ECG and Arrhythmia • ECG in Myocardial Infraction, Myocardial Ischemia • ECG in Miscellaneous Conditions: Metabolic, electrolyte changes • ECG for Technician: Summary
	Exercise ECG	<ul style="list-style-type: none"> • Equipments / Types of Exercise ECG • Indication / Contradiction • Lead Placement – Rationale, Limitation • Monitoring during Ex. ECG: Clinical / ECG / Parameters • Exercise ECG Protocol: Indications / Advantage and Disadvantage • Exercise Physiology • Exercise ECG: Preparation of Patient / Equipment / Defibrillators, Emergency Drugs • Exercise ECG: Detection of Various Arrhythmias, Ischemia, and Plan of action • Exercise ECG: • Endpoints: Recognition and Action

APPENDIX II - BCVT SYLLABUS

		<ul style="list-style-type: none"> • Post Exercise ECG: Observation, Instructions
	Echocardiography	<ul style="list-style-type: none"> • Principle of Echocardiography • Transducers • Anatomical Planes for Viewing in Echocardiography • Normal M-Mode Echo Study: Anatomy / Function: Measurements • Normal 2D Echo Study: Anatomy / Function: Measurements. • Echo for Cardiac Function- systolic and diastolic • Echo in Heart Disease: Acquired • Echo in Heart Disease: Congenital • Contrast Echocardiography: Technique and Indications • Transesophageal echocardiography • Echo Cardiography: Technician's Role:
		<ul style="list-style-type: none"> ☐ Disposables ☐ Archiving ☐ Record Keeping ☐ Stock-Indents, Stock Maintenance, Stock Verification
		<p>Principle of Doppler</p> <p>Measurement of Flows and Gradients</p> <ul style="list-style-type: none"> • Assessment of gradients, shunts, valve areas, cardiac output • Assessment of valve regurgitations <p>Utility of Doppler in Assessment of Cardiac Disease</p> <ul style="list-style-type: none"> • Tissue Doppler <p>Stress Echocardiography: Protocols, 2D Echo Views, Analysis</p> <p>Trans -esophageal Echo</p> <ul style="list-style-type: none"> ☐ Indication / Contraindication ☐ Patient Preparation ☐ Transducer: Maintenance, Sterilization, Handling etc. ☐ Monitoring ☐ Emergency Drugs

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		<ul style="list-style-type: none"> <input type="checkbox"/> Utility <input type="checkbox"/> 8. Intra Vascular Ultrasound, Intracoronary Doppler wire
	Holter Recording	<ul style="list-style-type: none"> • Principles of Holter • Utility and indications • Analysis of Holter
III YEAR	<ul style="list-style-type: none"> • Cardiac Catheterization Part I -Introductory Course 	<ul style="list-style-type: none"> • Cardiac Catheterisation: Laboratory Setup / Types of Procedures • Sterile Techniques in Cath Lab / Sterile Areas, Sterile Procedure, sterile trolley setting, Scrubbing, gowns and Gloves, scrubbing and draping Patients, handling sterile disposables etc. • Sterilisation and re-use of hardware • Equipments: Cath-Lab Equipments • <input type="checkbox"/> Defibrillator / Pacemaker / IABP / BOYLE's Apparatus / Suction Machine/oxygen • <input type="checkbox"/> Infusion Pumps / Programmed Stimulators, Pacing System Analysers • Equipments in Cath-Lab • <input type="checkbox"/> Hemodynamic Recorders (Physiological Records) • <input type="checkbox"/> Transducers • <input type="checkbox"/> Recording of Pressure Wave Form: • Range / Gain / Speed / Systolic / Diastolic And Mean Pressures In Chambers And Vessels • Hazard Management • <input type="checkbox"/> Radiation Protection • <input type="checkbox"/> Infection Prevention • <input type="checkbox"/> Injury Prevention: Electrical /Mechanical • Wastes Management • <input type="checkbox"/> Plastics • <input type="checkbox"/> Biological Wastes • <input type="checkbox"/> Glass / Needle / Syringes • Technician's Role • <input type="checkbox"/> Patient monitoring

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		<ul style="list-style-type: none"> • <input type="checkbox"/> Procedure Related : Data collection • <input type="checkbox"/> Acquisition and entry of Data, Procedure Books, Log Books, Registers etc. • <input type="checkbox"/> Stock of all disposables Eg: Catheters etc. • <input type="checkbox"/> Stores (Disposable Items) • <input type="checkbox"/> Accounting (Used Items) • Equipment Maintenance • Cine Angiography: Cine Filming, Cine Film Processing and Cine Film Viewing , cine film library • Contrast Media
	Cardiac Catheterisation – Part-II	<ul style="list-style-type: none"> • Cardiac Catheterisation Procedure: Diagnostic Studies • Cardiac Catheterisation Procedure: Therapeutic / Interventional Procedures • Acquisition of Cath Data : Cardiac Output / Oximetry and Shunts • Acquisition of Cath Data: Pressures and Wave Forms; Recording Technique, Analysis • Angiography: Technique / Views / Contrast Media • Cardiac Catheterisation • Hardware :Catheters / Connections / Sheaths / Stopcocks / Wires / Angioplasty Catheters • Complication of Cardiac Catheterisation: Recognition and management • Cardiopulmonary Resuscitation • Special Procedures: <ul style="list-style-type: none"> • <input type="checkbox"/> Pericardial Tap • <input type="checkbox"/> Atrial Septostomy • <input type="checkbox"/> Endomyocardial Biopsy • <input type="checkbox"/> Balloon Angioplasty (Valve) • <input type="checkbox"/> Coronary Angioplasty <ul style="list-style-type: none"> • Case Study of Simple Cardiac Disease-

APPENDIX II - BCVT SYLLABUS

		<ul style="list-style-type: none"> • □ ASD, MS, Tetralogy of Fallot • Hardware Of Cardiac Catheterisation And Interventions • Venous and Arterial Check Flow Sheaths, Manifolds, 3-Way Stock Cocks etc. • Guide Wires and Dilators • Puncture Needles (Vascular Access Needles) • Woven Dacron Catheters: GL, NIH, Lehman, Woven Dacron Electrode Catheters • Flow Directed Catheters (Swan Ganz Type) Balloon Angio Catheters • Polyurethane Catheters: Pig Tail, Judkins, Coronary, Amplatz Coronary, Brachial Coronary, Sones Catheters • Guide Wires: Short, Normal Length, Exchange Length 'J' Tipped Movable Core, Tips, Deflectable Types • Valvuloplasty Catheters, Atrial Septostomy Catheters • Coronary Angioplasty: Guide Catheters, Guide Wire, Balloon Dilatation Catheters, Indiflators, Y Connectors <ul style="list-style-type: none"> ○ Stents: Bare Stents, Mounted Stents, Other Types of Stents
	Cardiac Catheterisation Part III Pacing and Electrophysiology	<ul style="list-style-type: none"> • Arrhythmias: Brady and Tachy Arrhythmias • Indication For Temporary / Permanent Pacing Technique: Temporary Pacing • Permanent Pacing: VVI, AAI Pacing (Single Chamber Pacing)

APPENDIX II - BCVT SYLLABUS

		<ul style="list-style-type: none">• Permanent Pacing: DDD , other Modes of Pacing• Pacemaker Clinic: Management of Pacemaker Patients, programmers• Intracardiac Electrogram – Technique• Intracardiac Electrogram – Analysis, Intervals etc.• Electrophysiological Studies• Radio Frequency Ablation for Arrhythmia's• Implantable Cardioverter Defibrillator
		<ul style="list-style-type: none">• Cardiac Arrest• Cardio Respirator Resuscitation• Hypotension / Hypertensive Crisis• Cardiac tamponade• Anaphylaxis• Emergency Drugs• Intra-aortic Balloon Pump• Records Keeping: Indents, Stocks, Log Books, Procedure Books etc.