SRI VENKATESWARA INSTITUTE OF MEDICAL SCIENCES

TIRUPATI – 517 507

(A University established by an act of Andhra Pradesh State Legislature)

PG Programme in Allied Health Sciences

M.Sc Echocardiography

TIRUMALA TIRUPATI DEVASTHANAMS

INDEX

General Regulations

1. **Title of the Course**
   Master of Science degree in Echocardiography
2. **Duration of the Course**
   The duration of the course shall be 2- years on full time basis
3. **Eligibility for Admission**

   a) B. Sc in Cardiovascular Technology (3 yrs)
   (or)

   b) B.Sc Degree + 2 years PG diploma in ECG & CVT + 3 years Experience. Three years of Experience post 2 years Diploma in cardiovascular technology. Post general B.Sc. Degree from reputed institution on regular basis. correspondence course will not be considered.
4. **Selection Criteria**
   Selection shall be based on the academic merit/entrance test conducted in the qualifying exam.
5. **Admission schedule :**
   a) Commencement of Course: August every year
   b) The admissions are closed by 30th September or 60 days from the date of commencement of the programme.

5. Medium of instruction.

English shall be the medium of instruction for the subjects of study as well as for the Examination.

6. Course of study

The course shall be pursued on full time basis. In the end of first year there shall be an examination. Students shall be posted to SVIMS and SPMC hospitals during the practical hours.

Subjects for study and teaching hours for first year and second year of the PG courses are shown below.

Distribution of Teaching Hours
First Year

S.No.	Main subject	Theory No. of Hours	Practical No. of Hours	Total
1.	Embryology & Ultrasound Physics	46	120	166
2.	Clinical Cardiology	47	120	167
3.	Echocardiography for Ischemic/Valvular Heart Disease	57	140	197
4.	Epidemiology & Biostatistics	60	-	60
5.	Subsidiary subject: Medical Ethics	10	-	10
	Total:	220	380	600

Second year

S.No.	Branches	Theory No. of Hours	Practical No. of Hours	Total
6.	Paediatric Echocardiography	46	140	186
7.	Echocardiography in Myocardial, Pericardial, Aortic and Systemic Disorders& Non Cardiac Diagnosis	47	125	172
8.	Recent Advances	47	125	173
	Total:	140	390	530

8 a) Attendance:

A candidate is required to put in minimum 80% of attendance both in theory and practical separately of each paper before admission to the university examination. Participation in NCC, NSS, sports and games, educational tours, professional meetings and conference or other co-curricular activities representing the institution/university will not count as absence.

b) Condonation for lack of attendance:

The condonation of attendance on medical grounds or on absence under extraordinary circumstances to those who are having the attendance between 70% and 79% in each paper will be granted in genuine cases. The students who have shortage of attendance in the particular papers have to apply to the controller of examinations, indicating the reasons for shortage of attendance. The representation to be forwarded by the HOD & Prof. i/c AHS. If the reason is on the medical grounds, the relevant medical certificate has to be enclosed to the representation. If any student falls below the 70% of attendance, he/she will not be allowed to write the university examinations.

9. Scheme of examination

a) The examination for the degree shall consist of written papers, practical and oral.
b) There shall be two examinations viz. Preliminary and final. The preliminary examination shall be taken at the end of the first year. The final examination shall be taken at the end of 2^{nd} year.
c) The examination shall be conducted ordinarily twice a year, viz. July/August and January/February.

Preliminary Examination

This consists of theory, practical and oral. There will be separate papers for each specialization.

University Examination and Distribution of marks

First year

S.No	Subjects	Paper	Theory		Practical (Marks)		Viva	Grand Total
			IA	UE	IA	UE		
1.	Embryology & Ultrasound physics	I	20	80	15	60	25	200
2.	Clinical cardiology	II	20	80	15	60	25	200
3.	Echocardiography Ischemic/valvular heart disease	III	20	80	15	60	25	200
4.	Epidemiology & biostatistics	IV	20	80		-	-	100
	Total							700

Second year

S.No	Subjects	Paper	Theory		Practical (Marks)		Viva	Grand Total
			IA	UE	IA	UE		
5.	Pediatric Echocardiography	V	20	80	15	60	25	200
6.	Echocardiography in Myocardial, Pericardial, Aortic and Systmic Disorders & Non cardiac Diagnosis	VI	20	80	15	60	25	200
7.	Recent advances	VII	20	80	15	60	25	200
8.	Dissertation					100	50	150
	Total							750

Dissertation

The student should submit dissertation one month before the final examination. Those students who have not submitted the dissertation shall not be allowed to appear for the final examination. The dissertation shall be assessed at the time of orals by all the examiners.

The dissertation shall be written under the following headings:

Introduction; Aims or objectives of study; Review of literature; Materials and methods Results; Discussion; Conclusion; Summary; References; Tables; Annexure

The written text of dissertation shall not be less than 50 pages and shall not exceed 100 pages excluding references, tables, questionnaires and other annexure. It should be neatly typed in double line spacing on one side of paper (A4 size, 8.27" x 11.69") and bound properly. Spiral binding should not be done. A declaration by the candidate that the work was done by him/her

shall be included. The guide and head of the department shall certify the bonafide of the dissertation.

Three copies of dissertation shall be submitted to the university through proper channel along with a soft copy (CD), one month before the final examinations.

10. Internal assessment (IA):

a) A student must secure at least 35% marks of the maximum marks fixed for internal assessment in a particular subject to be eligible to appear for the university examination of that subject.
b) There shall be three internal assessment tests and the average of these tests shall be considered for awarding final marks.
c) If the candidate is absent for any of the exams, the marks in that exam shall be taken as zero.
d) The computed internal assessment marks as per the regulation 10 a) & b) shall be sent to the controller of exams 15 days before the commencement of the University exam.
e) The internal assessment marks should be signed by the concerned teaching faculty or HOD and counter signed by the HOD before being forwarded to the Controller of Examinations.
f) For those who failed in internal assessment test/s, have to reappear as per the regulation 9 a) & b) before he/she appears for the university examination.
g) For those who want to improve their marks in internal assessment tests, they can appear again as per the regulation 9 a) & b). For such students, the internal assessment marks of the student at the time of first appearance will be compared with the marks obtained at the present appearance and the higher of the two will be taken as his/her internal assessment marks.

11.Minimum for a pass

a) 35% in internal assessment of each theory paper and practicals/viva voce
b) 40% in each theory paper of university examination.
c) 50% on the total marks of theory university examination and internal assessment clubbed together, applicable to each paper.
d) Where, viva voce involved which is part of theory examination, 50% on the total marks of theory university examination, internal assessment and viva voce clubbed together, applicable to each paper.
e) Where there is no internal assessment marks, 50% on the total theory marks, 50% in practicals/viva voce applicable to each subject.

Note: For 2 year PG course, where any paper contains both theory and practicals/viva voce, the student has to pass both theory and practicals/viva voce, if any student pass in theory examination and fail in practicals/viva voce examination or vice versa, the student concerned has to appear again for both theory and practicals/viva voce examination.

12. Classification of successful candidates

Percentage of Marks for declaring Class:

Distinction	- 75% and above of the total marks.
First Class	- 65 - 74% of the total marks.
Second Class	- 50- 64% of the total marks.
Pass Class	- If the student does not pass all the subjects within

the duration of the course, the class will not be awarded and the final results will be declared as “Pass”. Those who have break in the middle of the course due to attendance shortage, it will be taken into consideration as not completed within the duration of the course and the final results will be declared as “Pass”.

13. Reappearance

The student has to pass both theory and practicals/via voce, if any student pass in theory examination and fail in practicals/viva voce examination or vice versa, the concerned student has to appear again for both theory and practicals/viva voce examination.

14. Carry-over Provision

The students are permitted to complete the course period irrespective of their success in the preliminary part. However, the final results will be kept under “withheld” until he/she passes all the previous papers”.

15. Maximum duration for completion of course

A candidate shall complete the course within four years from date of admission.

Failing which, the candidate will be discharged.

16. Eligibility for award of degree

A candidate shall have passed in all the subjects of first and second year to be eligible for award of degree.

M.Sc. ECHOCARDIOGRAPHY

FIRST YEAR

Course content (Syllabus) Theory

Paper I: Embryology and ultrasound Physics **Total hours: 47Hrs**

Unit No	Unit title	Unit objectives	Content	Hours	Method of evaluation
	Orientation and introduction to the course			1	-
1	Early development of embryo		mitosis, -meosis -Oogenesis -spermatogenesis -fertilization-formation of germ layers-formation of embryonic disc-placental formation	8	Sessional examination
2	Early blood vessel formation		Intra embryonic blood vessel - extra embryonic blood vessel	2	Sessional examination
3	Development of the heart		Heart tube formation -cardiac loop formation -interatrial septum formation, -interventricular septum formation -atrial formation -ventricular formation -formation of the cardiac valves -formation of the great systemic veins-aortic arch formation	10	
4	Basics of ultrasound	Ultrasound physics and instrumentation	Physical principles, -The transducer, Imaging by ultrasound –Image optimization & equipments -Signal processing -Tissue harmonic imaging-Artifacts	3	Sessional examination
5	Doppler Echocardiography		Principles of Doppler ultrasound -Doppler formats -CF imaging -Doppler artifacts-Tissue Doppler imaging-Doppler	10	Sessional examination

			application -Speckle tracking -Tissue characterization -The digital echo Lab –Storage & retrieval of echo Images, Post study processing and approaches to AFI,-Biological Effects of US		
6	Specialized Echocardiographic Techniques and methods		Hemodynamics, Use of echo to assess cardiac hemodynamics and guide therapy -Evaluation of 3D Echo, Transducer technology,	6	Sessional examination
6A	Basics of 3D US		Beam forming and rendering 3d quantification, 3d examination protocol and approach		
6B	TEE		Instrumentation and Examination-TEE views-complication and safety consideration		
7	Echocardiographic examinations	Cardiac chambers	LV systolic Function, LV diastolic Function, LA, RA RV Function, Echo in ICU, operative, pre-operative application	7	Sessional examination
		Stress Echocardiography	Methodology -Pharmacological stress echo-Interpretation -Stress echocardiography in valvular heart Disease		

Paper II: Clinical cardiology

Total hours: 47

Unit No	Unit Title	Unit Contents	Hours	Method of Evaluation
1	Introduction and basics	-	1	Sessional examination
2	Basic anatomy and physiology of the heart	Anatomy of the heart -Lymphatic system ,Arterial and venous supply of the heart -Conduction system and basic electrophysiology	3	Sessional examination
3	History and symptoms	Importance of history taking. -Causes of cardinal symptoms(Cardiovascular and non cardiovascular)- Assessment:-NYHA functional Classification -CCS functional classification -Specific activity scale -Chest Pain, Dyspnea, Shortness of breath, Palpitation, Fatigue, Syncope, Other symptoms: Hemoptysis, Hoarseness, Cyanosis, Fever	10	Sessional examination
4	General Examination	Facial appearance -Gesture and signs - Oral cavity-Skin, Extremities-Peripheral edema	4	Sessional examination
5	Arterial pulse	Definition –Genesis -Wave pattern-Examination of arterial pulse-Characteristic features of pulse in common clinical conditions	3	Sessional examination
6	Measurement of Blood pressure	Definition -Components and determinants of arterial blood pressure -Hypertension –Cause, mechanism and complications	2	Sessional Examination
7	Jugular venous pressure	Examination -Analysis-Abnormalities	2	Sessional Examination
8	Cardiovascular system examination	Inspection and palpation of the Precordium, Percussion	2	Sessional examination
9 Cardiac auscultation		Principle and Techniques First Heart sound Second heart sound Diastolic and systolic sounds Prosthetic valve sounds Extra cardiac sounds	4	Sessional examination
9A	Heart sounds			
9B	Heart Murmurs	Definition -Mechanism Characteristics -Systolic murmur		

		Diastolic murmur -Continuous murmur		
10 10A 10B	Basic investigation Chest X-ray Evaluating chest X-ray in heart disease:	 Normal chest X-ray Lung and Pulmonary vasculature Cardiac size Abnormal Densities and lucency Cardiac malposition Lungs and pulmonary vasculature Cardiac chambers Great vessels Pleura and pericardium Implantable devices and other post surgical findings	3	Sessional Examination
11	Clinical Electrocardiogram	Advanced ECG- ECG findings in Various cardiac Diseases -Clinical issues in ECG interpretation	4	Sessional examination
12	Cardiovascular pharmacology	Mechanism of action-Indications, Dosage -Precautions of cardiovascular Drugs, Atropine- Lidocaine - Procainamide- Verapamil and diltizem-Adenosine-Magnesium-Sodium Bicarbonate, Morphine-Calcium chloride -Dopamine- Dobutamine-Isoproterenol - Amrinone Sodium Nitroprusside -B- blockers: propranolol, Metoprolol, Atenolol-Diuretics -Thrombolytic agents: Streptokinase,Urokinase	10	Sessional examination

Paper III: Echocardiography for Ischemic and valvular heart disease

Total hours: 57hrs

Unit No	Unit title	Unit objectives	Content	Hours	Method of evaluation
1	Orientation and introduction to the course			1	Sessional examination
2	Ischemic Heart Disease	Echo cardiography and Coronary artery disease	Understanding Coronary circulation, -Pathophysiology of coronary artery syndrome -wall motion scoring,-Detection and quantification of RWMA -Global ventricular function,-myocardial infarction	3	Sessional examination
2A	Echo assessment Coronary arteries		Morphology and coronary flow reserve by TTE and TEE -Visualization of coronary arteries-Distal coronary Flow and coronary flow reserve	3	Sessional examination
2B	Congenital abnormalities		Anomalies and echo detection -Kawasaki Disease.	2	Sessional examination
2C	Echo in IHD		Detection of Ischemia -Role in acute coronary syndrome -Role in ischemic cardiomyopathy	3	Sessional examination
2D	Chronic coronary artery disease		LV aneurysm -Pseudo aneurysm, Chronic remodeling, Mural thrombus -MR –Ischemic cardiomyopathy	2	
2E	Echo in CCU		Management of acute MI – Pathophysiology and Echocardiographic correlation-Detecting and assessing MI,-correlation with coronary anatomy,-Prognostication following MI,-Complications of MI	3	Sessional examination
2F	Stress echocardiography		Fundamentals, Types of Stress Echo-Interpretation of stress Echo-Technical aspects of non exercise test -Protocol, reversible ischemia detection, inducible ischemia/-viability and sensitivity and specificity -Assessment of disease significance and prognostic evaluation	3	Sessional examination
2G	Echocardiography		Approach and clinical	2	Sessional

	evaluation of coronary blood flow		applications-Doppler evaluation of coronary flow -Technical aspects and detection-assessment and clinical application		examination
2H	Newer techniques and their application for IHD		TDI, Strain, Strain rate, vector imaging, -Myocardial contrast Echo	2	Sessional examination
2 I	Surgical aspects of IHD		Role of Echo cardiographer- pre and post operative evaluation for CABG, Ischemic MR-repair vs replacement -Coronary anomalies echo aspects Dorr's procedure	2	Sessional examination
3	Valvular Heart Disease	Valve anatomy	Mitral valve anatomy, -Mitral valve anatomy in surgeons view-Scallops of mitral valve in different echo views -Aortic valve anatomy -Tricuspid valve anatomy -Pulmonary valve anatomy	5	Sessional examination
3A	Echo in RF		Acute vs chronic RF and valvular involvement	2	Sessional examination
3B	Mitral valve disease		MVP, -Mitral regurgitation-etiology Mechanism, Severity assessment -Sequential Evaluation. Chronic asymptomatic MR-Indication and Timing of Intervention for chronic valvular regurgitation-Assessment of Mitral stenosis -Etiology,-Severity assessment, Indication and valve assessment for Mitral Intervention	6	Sessional examination
3C	Aortic valve		Aortic regurgitation -Etiology-Quantification of AR –severity - Timing of surgery -Aortic stenosis -Etiology, Valvular, subvalvular and supra valvular stenosis. -Severity assessment, Use of stress Echo and strain in evaluation of AS , Low gradient severe AS with depressed and preserved EF, Myocardial response to chronic AS.	4	Sessional examination
3D	Tricuspid valve		TR-etiology, Severity assessment, TS –etiology and severity assessment	2	
3E	Pulmonary valve		Pulmonary stenosis- valvular, supravalvular, Infundibular, Peripheral stenosis	4	

			Pulmonary regurgitation - Etiology and severity assessment, Ross procedure		
3F	Pulmonary hypertension		Etiology, PA pressure assessment by various methods	2	
3G	Infective Endocarditic		Dukes criteria Organisms, culture, Involvement of Valves, Indication for Echo, Prognostic stratification	3	
3H	Prosthetic valves		Types of prosthetic valves, Echo assessment in various valves, Prosthetic valve dysfunction, Prosthetic valve IE, Pannus formation and dehiscence, Fluid dynamics of PV, Recognition and quantification of PV Dysfunction , 3DE and TEE evaluation		

Paper IV: Epidemiology &Biostatistics

Total hours: 60

Sl. No.	Topics	60 Hours
1	**Introduction** Introduction to Biostatistics & Research Methodology, types of variables & scales of measurements, measures of central tendency and dispersion, Skewness and Kurtosis Rate, Ratio, proportion, incidence, prevalence and their meaning.	4
2	**Sampling** Random & non random sampling, various methods of sampling-simple random, stratified, systematic, cluster and multistage. Sampling and non sampling errors.	4
3	**Basic probability distribution and sampling distributions** Concept of probability distribution, normal, Poison and Binomial distributions, parameters and applications. Concept of sampling distributions. Standard error and confidence intervals.	6
4	**Tests of Significance** Basics of testing of hypothesis – Null and alternate, hypothesis, type I and type II errors, level of significance and power of the test, p value. Tests of significance (parametric) T – test (paired & unpaired), Chi square test and test of proportion, one way analysis of variance. Repeated measures analysis of variance. Tests of	10

	significance (nonparametric) – Mann Whitney U Test, Wilcoxon Test, Kruskal – Wallis analysis of variance Friedmann's analysis of variance.	
5	**Correlation and Regression** Simple correlation – Pearson's and Separman's methods ; testing the significance of correlation co-efficient simple and multiple linear regression.	4
6	**Sample size determination** General concept Sample size for estimating means and proportion, testing of difference in means, proportions of two groups and more than two groups.	4
7	**Study Designs** Descriptive epidemiological methods – case series analysis and prevalence studies. Analytical epidemiological methods – case control and cohort studies, Clinical trials / intervention studies, odds ratio and relative risk, stratified analysis.	10
8	**Multivariate analysis** Concept of multivariate analysis, introduction to logistic regression and survival analysis	6
9	**Reliability and validity evaluation of Diagnostic Tests** Cronbach's alpha and Test- retest methods	4
10	**Format of Scientific documents** Structure of Research protocol, structure of thesis/research report, formats of reporting in scientific journals. Systematic review and meta analysis.	8

Suggested Reading

1. Surendar a Rao PSS and J Richard. Introduction Biostatics an Research Methods, Prentice Hall of India (2006).
2. Abhaya Indrayan and Rajeev Kumar Malhotra, Medical Biostatics, 4th Editiin, CRC Press (2017)
3. Indrayan and Satyanarayana, Biostatics for Medical, Nursing and pharmacy students, prentice Hall of India (2006)
4. Sarma K.V.S, Statistics made simple – do it yourself on PC, 2nd edition, Prentice Hall (2010)

Subsidiary Subject

Ethics in Echocardiography: 10 HRS

(Should be taught to the 1st year students of M.Sc. Echocardiography)

Introduction: With the advances in science and technology and the increasing needs of the patient, their families and community, there is a concern for the health of the community as a whole. There is a shift to greater accountability to the society. It is therefore absolutely necessary for each and every one involved in the health care delivery to prepare them to deal with these problems. Other professionals are confronted with many ethical problems.

Standards of professional conduct are necessary in the public interest to ensure an efficient laboratory service. Every sinologists or sonographer should not only be willingly to play his part in giving such a service, but should also avoid any act or omission which would prejudice the giving of the services or impair confidence, in respect, for sinologists or sonographer as a body.

To accomplish this and develop human values, it is desired that all the students undergo ethical sensitization by lectures or discussion on ethical issues.

Introduction to ethics-
What is ethics?
General introduction to Code of Laboratory Ethics
How to form a value system in one's personal and professional life?
International code of ethics

Professional Ethics-
Code of conduct
Confidentiality
Fair trade practice
Handling of prescription
Mal practice and Negligence
Professional vigilance

Research Ethics-
Animal and experimental research/ humanness Human experimentation
Human volunteer research - informed consent Clinical trials
Gathering all scientific factors
Gathering all value factors
Identifying areas of value – conflict, setting priorities
Working out criteria towards decision
ICMR/ CPCSEA/ INSA Guidelines for human / animal experimentation

Recommended reading

Francis C.M., Medical Ethics, I Edition, 1993, Jay pee Brothers, New Delhi p189.

Good Clinical Practices: GOI Guidelines for clinical trials on Pharmaceutical Products in India (www.cdsco.nic.in)

INSA Guidelines for care and use of Animals in Research – 2000.

CPCSEA Guidelines 2001(www.cpcsea.org).

Ethical Guidelines for Biomedical Research on Human Subjects, 2000, ICMR, New Delhi.

ICMR Guidelines on animal use 2001, ICMR, New Delhi.

PRACTICALS

Paper –I: Embryology and ultrasound physics - 120 Hours

1. **Echocardiographic demonstration: 5Hours**

Candidate will be allocated equipment for demonstration of procedure of maintenance,

Will be required to accompany service engineers and biomedical engineers during service visits and prepare at least six analyses of error and corrective actions taken

Candidate will be required to perform rapid studies during OP peak hours under supervision and will participate in subsequent debriefing

Will assist consultant in quality control exercise on a weekly basis.

2. Basic Echocardiographic principles: 5 Hours

Transducer selection

Reduction of artifacts

Obtaining optimal gray scale images

Gain and depth controls

Use of M-mode for temporal analysis of cardiac events and obtaining measurements

Use of modalities to optimize colour flow such as colour maps, gain and scale

Adjustments related to Doppler such as scale, PRF, sweep, angle correction

Use of specialized techniques such as Tissue Doppler

3. Echocardiographic examination (10 Hours)

Will be required to perform calculations such as left ventricular mass and cardiac output, Calculation of cardiac mass,

Doppler equations, stroke distance, converting velocity to flow, flow to volumes, cardiac output, shunt ratios, modified Bernoulli equation and intra-vascular pressures, assessment of left ventricular, left atrial, right ventricular, right atrial pressures

Candidate would be required to store and retrieve studies of diagnostic quality-clinician satisfaction will be taken as a yardstick for performance

Applications of principles to obtaining, storing and retrieving optimal images.

Clinical lab posting: 75 hours

Students will be posted in the echocardiographic laboratory for the observation and to develop practice in the routine cardiac investigation by echocardiography.

Hands on practical work: 25hours

Students will be allowed to perform echocardiographic test independently under the supervision of the faculty to develop the skill and experience.

Paper-II : Clinical cardiology 120 hours

Clinical scenario given to the candidate for diagnosis and treatment of following disorders:

150 Hr

a. Unstable angina
b. Myocardial infarction
c. Left ventricular aneurysm
d. Congestive heart failure
e. Cardiac arrhythmia
f. Atrial septal defect
g. Ventricular septal defect
h. Tetralogy of Fallot
i. Hypertension

Cardiac Surgery

5 Hours

Brief description of surgical steps involved in:

a. Coronary artery bypass grafting (on pump CABG)
b. Mitral valve replacement
c. Aortic valve replacement
d. ASD closure
e. VSD closure
f. Off-pump CABG

Clinical lab posting: 75 hours

Students will be posted in the echocardiographic lab, for the observation and to identify the correlation of clinical diagnosis with the echo findings with the help of clinical features, blood investigations, ECG, X-RAY etc.

Students will be recruited to the operation theater for the observation of the cardiac surgeries and to understand various technics.

Students will be allowed to attend ward rounds with the cardiologists.

Students will be demonstrated for ACLS and BLS, and posted clinically in ICCU for the observation and experience.

Hands on practical work: 25hours

Students will be allowed to read ECG and report X-RAY, perform echocardiographic test independently under the supervision of the faculty.

Paper –III : Echocardiography for Ischemic valvular heart disease - 140 Hrs

Ischemic and valvular heart disease, Echocardiography for ischemic heart disease

20 Hours

1. **Understanding coronary circulation:** Coronary anatomy and physiology, pathogenesis of atherosclerotic plaques, abnormalities of coronary perfusion, wall thickening
2. **Wall motion scoring:** Regional left ventricular function, relationship to vascular supply, use of tissue Doppler where indicated, Segmental analysis for wall motion defects, coronary artery territories, detection and quantitation of Ischaemic muscle-wall motion scoring,
3. **Global ventricular function:** Linear measurements: indirect M-Mode markers of left ventricular function; Assessing global LV function; Evaluation of diastolic function: Methods for evaluating diastolic function, Doppler evaluation of diastolic function, Evaluation of mitral inflow, determination of isovolumic relaxation time, Evaluation of pulmonary vein flow, Doppler tissue imaging, Assessment of overall performance of the Ischemic left ventricle-systolic and diastolic function, estimating volumes rule of disks.
4. **Myocardial infarction:** Detecting and assessing MI, co-relation with coronary anatomy, prognostication following MI.
5. **Complications of MI**: Aneurysm, pseudo aneurysm, Ventricular Septal Defect, thrombi-embolic potential, right ventricular involvement.
6. **Stress echocardiography:** Protocols for stress echocardiography, detection of reversible Ischemic, detecting inducible ischemia/viability, specificity and sensitivity
7. **Newer techniques and their applications for IHD:** Tissue Doppler, strain, strain rate and velocity vector imaging, studying myocardial perfusion using contrast echocardiography.
8. **Surgical aspects of IHD-role of echo cardiographer:** Pre and postoperative evaluation for Coronary Artery Bypass Grafting (CABG), Linear endo-ventricular patchplasty (Dorr's procedure), Mitral regurgitation- morbid anatomy repair versus replacement decision/post-operative, coronary anomalies-echocardiographic aspects.
9. **Recent developments in echocardiography for ischemic heart disease Textbooks and Reference Books:**
    1. Echocardiography by Feigenbaum (Latest Edition)
    2. Echo manuals by Mayo Clinic Lecture notes.
    3. Journal articles
    4. Cardiology by Braunwald and Hurst (Latest edition)

Echocardiography for valvular heart disease **20 Hrs.**

1. **Hemodynamic information derived from echocardiography:** Aortic flow, pulmonary flow, mitral flow, left atrial flow, tricuspid valve flow, cardiac output, regurgitant fraction shunt ratios, echocardiographic detection of stagnant blood flow, modified Bernoulli equation and intravascular pressures, echocardiographic findings with elevated left ventricular diastolic pressure, elevated left atrial pressures, pulmonary hypertension, right ventricular pressure, right atrial pressure.

2. **Mitral stenosis:** Etiopathogeneisis, pathophysiology and hemodynamics, two-dimensional echocardiography in rheumatic mitral stenosis, congenital mitral stenosis, M-model echocardiographic appearance, transoesophageal echocardiography, three dimensional echo assessment for severity, anatomic determination of severity, exercise gradients, secondary features of mitral stenosis, Atrial fibrillation, secondary pulmonary hypertension, decision making regarding intervention; assessment for balloon mitral valvotomy-transesophageal echocardiography and its uses, post-procedural assessment,open mitral valvotomy versus mitral valve replacement- pre and post-operative assessment.

3. **Mitral regurgitation:** Doppler evaluation of mitral regurgitation, determination of mitral regurgitation, severity, Mitral valve prolapse and analysis of segments, Haemodynamics of MR, diagnosis of MR, assessing severity and secondary effects, pre-op, intra-op and post-operative, assessment for mitral valve repair, use of three dimensional echocardiography for mitral valve surgery, flail mitral valve, papillary muscle dysfunction. mitral annular calcium
4. **Tricuspid valve disease:** Anatomy and physiology of the healthy valve structural and functional changes in various disease states organic and functional involvement, tricuspid stenosis, tricuspid regurgitation and assessment of severity, approach to pulmonary artery hypertension.
5. **Aortic stenosis:** Etiopathogenesis and haemodynamics, sub-valvular, valvular and supravalvar lesions, cuspal morphology, diagnosis and assessment of secondary effects, time course and prognostication, pre-operative and post-operative assessment; Diagnosis, assessing mechanism and severity, assessing site, possible etiology, secondary effects such as LV function, impact on associated lesions and therapeutic approach
6. **Aortic regurgitation**: Etiopathogenesis and haemodynamics, secondary effects, establishing a diagnosis, evaluating the severity of aortic regurgitation, acute versus chronic aortic regurgitation, relevant aspects of left ventricular function, timing of surgery, pre-operative and post-operative assessment.
7. **Pulmonary valve disease:** Embryology, morphology, infundibular, valvular, supra valvular and peripheral pulmonic stenosis, evaluation of the right ventricular outflow tract, miscellaneous abnormalities of the pulmonary valve assessing severity of pulmonic stenosis, pre and post procedural assessment for pulmonary valvuloplasty, pulmonary regurgitation.
8. **Prosthetic valves:** Types and normal function of mechanical valves, stenosis regurgitation, use of tranesophageal echo for prosthetic valves, endocarditis: and its sequelae in native and prosthetic heart valves.

9. **Recent developments in echocardiography for valvular heart disease** Candidate would be allocated one or two patients/cases who are diagnosed with above (ischemic or valvular lesions) conditions, once in a week. They will be allowed to formulate the diagnostic question independently. The candidate will be analyzed by the faculty for the performance on the basis of diagnostic skill with the interpretation of the disease and looked for the knowledge on treatment modality. This will be followed by the brief discussion.

Textbooks and Reference Books:

1. Echocardiography by Feigenbaum (Latest Edition)
2. Echo manuals by Mayo Clinic Lecture notes.
3. Journal articles Cardiology by Braunwald and Hurst (Latest edition)

Clinical lab posting: 75 hours

Students will be posted in the echocardiographic laboratory for the observation and to develop practice in the cardiac investigation in ischemic and valvular heart disease by echocardiography.

Hands on practical work: 25hours

Students will be allowed to perform echocardiographic test independently under the supervision of the faculty to develop the skill and experience.

Second Year – Theory

Paper V: Paediatric Echocardiography

Total hours: 46Hrs

Unit No	Unit title	Unit objectives	Content	Hours	Method of evaluation
1	Orientation and introduction to the course			1	Sessional examination
2	Fetal cardiac Imaging		Indications for fetal cardiac evaluation Fetal physiology-Indications for fetal echocardiography	2	Sessional examination
3	Echo examination		A segmental approach to anatomy-Cardiac situs - Ventricular morphology -Great arterial connections	2	Sessional examination
4	Abnormalities of RV inflow			1	Sessional examination
5	Abnormalities of LV inflow		-Pulmonary veins - Left atrium-Mitral valve	2	Sessional examination
6	Abnormalities of RV outflow		- Right ventricle-Pulmonary Valve-Pulmonary artery	2	
7	Abnormalities of LV outflow		-Subvalvular Obstruction - Valvular aortic stenosis -Supravalvular aortic stenosis	2	Sessional examination
8	Coarctation of aorta			2	Sessional examination

9	Abnormalities of cardiac septation		Atrial septal defect- -Ventricular septal defect-Endocardial cushion defect	3	Sessional examination
10	Abnormal vascular connections and structures		Patent ductus arteriosus- Abnormal systemic venous connection Abnormalpulmonary venous connection-Abnormalities of the coronary circulation	2	Sessional examination
11	Cono truncal abnormalities		-Tetralogy of Fallot -Trans position of the great arteries,- Double outlet Right ventricle- Persistent truncus arteriosus- Aorto pulmonary window	3	Sessional examination
12	Abnormalities of ventricular development		Hypoplastic left heart syndrome -single ventricle- Tricuspid atresia	3	Sessional examination
13	M-mode and 2D in CHD		Basics of imaging and sequential segmental analysis - Left to right shunts -Atrio ventricular septal defect Congenital left ventricular and right vedntricular inflow anomalies -Left ventricular outflow tract obstruction. Echocardiographic anatomy of TOF with PS-Complete transposition of great arteries- AV/VA discordance- Pulmonary veins-Imaging of coronary anomalies and pulmonary arteries- Echocardiographic evaluation of aortic arch and its anomalies-Univentricular heart and heterotaxy syndrome.	10	Sessional examination
14	3D echo in CHD For quantification of ventricular volumes, Mass and function with CHD		LV volume, EF and Mass-RV volume, EF and Mass -Single ventricular volumes, EF and mass -3D analysis of regional wall motion, Synchrony and strain	3	Sessional examination
15	Echo in the evaluation of adults with CHD		Simple congenital heart defects in adults Valvular heart disease Complex congenital heart	2	

			defects		
16	Echo evaluation during and after surgery		Systemic artery to pulmonary artery shunts Pulmonary artery bands Fontan procedure -Right ventricle to pulmonary artery conduits	3	Sessional examination
17	Echo evaluation of acquired heart disease in childhood		IE-Modified DukeCriteria for the diagnosis of IE Echo findings in Complications of IE . RHD-Johns criteria. Kawasaki disease - Coronary ectasia and aneurysms	3	Sessional examination

Paper VI: Echocardiography in Myocardial, Pericardial, Aortic and Systemic Disorders & Non-Cardiac Diagnosis

Total hours: 47

Unit No	Unit title	Unit objectives	Content	Hours	Method of evaluation
1	Orientation and introduction to the course			1	Sessional examination
2 2A	Echo in cardiomyopathies Hypertrophic cardiomyopathy		Definition and types of hypertrophy -Mid LV hypertrophic cardiomyopathy -Differential Diagnosis Treatment strategies	12	Sessional examination
2B	Dilated cardiomyopathy		Secondary findings in DCM -Etiology of DCM-Doppler evaluation of systolic and diastolic function -Therapeutic decision		
2C	Infiltrative and Restrictive cardiomyopathy		Echo evaluation of RCM -Constrictive versus restrictive heart disease		
2D	Peripartum cardiomyopathy				
2E	Non-compaction LV/RV cardiomyopathy				
2F	Endocardial fibro				

	elastosis and hyper eosinophilic syndrome				
3	Echocardiographic Differentiation of ischemic and non ischemic cardiomyopathy		Echocardiographic assessment of ischemic and non ischemic cardiomyopathy -M-mode echocardiography -2D/3D /Doppler echocardiography - Distinction between ischemic and non ischemic dilated cardiomyopathy-Other non invasive imaging modalities	10	Sessional Examination
4	Pericardial disease		Acute pericarditis - Pericardial effusion , M-Mode and 2D echocardiography-Cardiac tamponade -Constrictive Pericarditis –Congenital anomalies-3D echo assessment in pericardial disease -2D versus 3D echocardiography	5	Sessional examination
5	Diseases of the Aorta		Echocardiographic Evaluation -Aortic dilatation and Aneurysm - Marfan' syndrome - Sinus of valsalva aneurysm - Aortic dissection -Aortic pseudo aneurysm, Aortic Trauma-Infections of the aorta- Aortic prosthesis thrombus -Takayasu arteritis	5	Sessional examination
6	Echo in systemic disease		Hypertension -DM-Connective tissue /auto immune disease-Chronic liver disease-COPD -Pulmonary hypertension	5	Sessional examination
7	Echocardiography in the Elderly		Aortic atherosclerosis and penetrating aortic Ulcer - Aortic valve Sclerosis - Aortic stenosis -Aortic	5	Sessional examination

			aneurysm- Aortic Dissection -LV Masses, Dimensions and function- Echocardiography in stroke patients -Mitral annular calcification- Prosthetic valves		
8	Echocardiographic assessment of Cardiac Tumors and Masses		Echocardiographic assessment of cardiac tumors and masses- Primary Benign cardiac tumors -Malignant primary cardiac tumors	4	Sessional examination

Paper VII: Recent advances

Total hours: 47

Unit No	Unit title	Unit objectives	Content	Hours	Method of evaluation
1	Orientation and introduction to the course			1	Sessional examination
2	Monitoring ventricular function in the operating room		LV filling -Global systolic Function, Regional wall motion abnormality-Use of TEE in operating room to monitor cardiac function in specific cardiac enteties	2	Sessional examination
3	Contrast ultrasound imaging, Method, Analysis and Application		Characteristics of microbubbles Ultrasonographic contrast agent, Ultrasonographic imaging technique-Method of analysis-Clinical applications of ultrasonographic contrast- Myocardial contrast echocardiography, Indications for use of ultrasound contrast- Safety of ultrasound contrast	3	Sessional examination
4	Myocardial perfusion echocardiography		Acute coronary syndromes Assessment of myocardial viability Chronic coronary artery disease	2	Sessional examination
5	Endothelial Dysfunction		Endothelial function and Dysfunction -Role of Acetylcholine -Shear stress and	3	Sessional examination

			flow mediated Dilatation-NO Release-Methodology for Assessing endothelial function-Analysis of shear stress and flow mediated dilatation response-Factors affecting the flow mediated dilatation-Limitations -Other non invasive methods to assess endothelial function		
6	3D- Transthorasic and TEE echo examination and performing		3D TEE Technology -Performing 3D TEE -Evaluation -Specific uses of 3D TEE	2	Sessional examination
6A	3D TEE to evaluate valvular heart disease.		3D echo image optimization-3D echo of the mitral valve -3D echo of the aortic valve-3D echo of the pulmonic valve -3D echo of the Tricuspid valve	2	
6B	3D TEE in operating room		Mitral Valve disease-Aortic valve disease-Tricuspid valve disease-Native valve endocarditis-Prosthetic valve dysfunction-Cardiac masses	2	
6C	3D guidance of Percutaneous procedures		Fluoroscopy versus echocardiography in guiding percutaneous interventions-Transseptal puncture, Device closure of cardiac shunts-Occlusion of the LA appendage- Guidance for electrophysiology procedures, Miscellaneous procedures	4	
7	Speckle tracking echocardiography; clinical usefulness		Cardiac muscular anatomy-what is strain-2D speckle tracking echocardiography -Image acquisition and processing - Clinical application of 2D STE-3D speckle tracking echocardiography - Clinical applications of 3D STE-Limitation	3	Sessional examination
8	Intra cardiac echocardiography		Equipment and the Catheters-Imaging specification-clinical	2	Sessional examination

			applications-intra cardiac echocardiography during EP intervention -During structural intervention		
9	Intravascular ultrasound imaging		Principles of Ultrasound - Technology-Image acquisition- Intravascular ultrasound examination Image interpretation -Utility of intravascular ultrasound in clinical practice	3	Sessional examination
10	Peripheral vascular ultrasound		Ultrasound diagnosis of carotid artery diseases Ultrasound diagnosis of Femoral access complications	2	Sessional examination
11	Advanced Non invasive Quantification Techniques in echocardiography		Clinical applications of advanced 3D echo quantification tools -RV quantification -Mitral valve assessment -Aortic valve assessment -Conclusion	3	Sessional examination
12	Echocardiography in Women		Structural heart disease:-MVP, Mitral stenosis, Mitral annular calcification -Ischemic heart disease -Stress echocardiography -Polycystic ovarian Syndrome -Takotsubo cardiomyopathy-CHD -Echocardiography in pregnancy-Peripartum cardiomyopathy-Fetal echocardiography	2	Sessional examination
13	Echo for the Electrophysiologist		Echocardiography in SVT-Left atrium Atrial septum-Pulmonary veins-Inferior venacava-Echocardiography in VT-Echocardiography in cardiac Implantable electronic devices	3	Sessional examination

14	Echo in life threatening conditions		Chest trauma-Penetrating chest trauma- Acute Mitral regurgitation Acute severe AR -Aortic dissection –Debakey classification -The Stanford classification Pulmonary thromboembolic Disease -Air embolism Hypovolemia -Large intracardiac thrombus	4	
15	A Primer on cardiac MRI for the Echo cardiographer		Quantitative left and right ventricular assessment -Strain assessment LV structure -Myocarditis and Sarcoidosis-cardiac hypertrophy,Cardiomyopathies -Velocity Mapping, Flow and shunt Assessment -Valvular heart disease and prosthetic valves	3	Sessional examination
16	Fetal echocardiography		Echocardiography in diagnosis of heart disease in pregnancy-Indication-Extra cardiac reasons and associations for fetal heart disease - Fundamentals of fetal cardiac imaging	2	Sessional examination

PRACTICALS

Paper - V: Paediatric Echocardiography 140 HRS

40 Hours

1. Paediatric echocardiography: Segmental approach, Assessing visceral and cardiac situs, veno-atrial connection, atrio-ventricular and ventriculo-great artery relation, Ventricular loop, Great artery position, Aortic arch visualization.
2. Abnormalities of right ventricular inflow
3. Abnormalities of left ventricular inflow: Pulmonary veins, left atrium, and mitral valve.
4. Abnormalities of right ventricular outflow: Right ventricle, pulmonary valve, pulmonary artery
5. Abnormalities of left ventricular inflow: sub-valvular obstruction, Valvular aortic stenosis, supravalvular aortic stenosis.

6. Coarctation of the aorta
7. Abnormalities of cardiac septation: Atrial septal defect, ventricular septal defect, endocardial cushion defect.
8. Abnormalities vascular connection and structures: patent ductus arteriosus, abnormal systemic venous connections, abnormal pulmonary venous connections, abnormalities of the coronary circulation.
9. Cono-truncal abnormalities: Tetralogy of Fallot, transposition of the great arteries, double outlet right ventricle, persistent truncus arteriosus and aortopulmonary window.

Candidate would be allocated one or two patients/cases who are diagnosed with above conditions, once in a week. They will be allowed to formulate the diagnostic questions independently. The candidate will be analyzed by the faculty for the performance on the basis of diagnostic skill with the interpretation of the disease and looked for the knowledge on treatment modality. This will be followed by the brief discussion.

Clinical lab posting: 75 hours

Students will be posted in the echocardiographic laboratory for the observation and to develop practice in the cardiac investigation of congenital heart disease by echocardiography.

Hands on practical work: 25hours

Students will be allowed to perform echocardiographic test independently under the supervision of the faculty to develop the skill and experience.

Paper - VI: Echocardiography in Myocardial, Pericardial, Aortic and Systemic Disorders & Non-Cardiac Diagnosis -125Hrs

25 Hours

1. **Hypertrophic Cardiomyopathy**: Morphological variants, diagnosis, haemodynamics, echocardiography evaluation of hypertrophic cardiomyopathy, assessing intracavitary and outflow tract gradients in obstructive cardiomyopathy, Mitral regurgitation in hypertrophic cardiomyopathy, other variants of hypertrophic cardiomyopathy, mid-cavity obstruction, conditions mimicking hypertrophic cardiomyopathy, therapeutic decision making and monitoring in hypertrophic cardiomyopathy, evaluation of therapy, pre and post-procedural evaluation.

2. **Idiopathic dilated cardiomyopathy:** Diagnosis and differentiation from other disorders such as IHD, Doppler evaluation of systolic and diastolic function, secondary findings in dilated cardiomyopathy, etiology of dilated cardiomyopathy, determination of prognosis in dilated cardiomyopathy, pre and post-procedural evaluation for cardiac re-synchronization therapy. Overview of cardiac transplantation.
3. **Restrictive Cardiomyopathy:** Diagnosis and haemodynamics, infiltrative cardiomyopathies, miscellaneous- myocardial diseases in neuromuscular disorders, infectious agents and toxins.

4. **Diseases of the pericardium:** Pericardial effusion: Detection of fluid, diagnosis-pleural versus pericardial fluid, quantitation, loculated effusions, cardiac tamponade-diagnosis, haemodynamics etiology, pericardiocentesis, Constrictive pericarditits: Diagnosis and haemodynamics. Differentiation from restrictive Cardiomyopathy, pre and post-surgical evaluation. Miscellaneous: acute pericarditis, pericardial thickening, pericardial cysts, absent pericardium.
5. **Diseases of the aorta:** Aortic dilatation and aneurysms, Aortic dissection-diagnosis and classification, false aneurysms, aneurysms of the aortic sinuses-rupture,haemodynamics, pre-and postsurgical evaluation.Miscellaneous-rauma, infections, aorta-left-ventricular tunnel, atherosclerosis, echocardiographic evaluation, aortic dilation and aneurysm, marfan syndrome, Sinus of valsalva aneurysm, aortic atheroma. Role of trans-esophageal echocardiography.
6. **Echocardiography in systemic disorders:** Diabetes hypertension, renal failure, neurological conditions, collagen vascular diseases and so on.
7. **Cardiac masses:** Tumors and source of embolus: Normal variants and artifacts, cardiac tumors; primary tumors, metastatic tumors of the heart, secondary effects, Masses, extra cardiac masses, intra cardiac thrombi, ultrasonic typing, man-made objects in the heart; Intra-cardiac thrombi: left ventricular thrombi, left atrial thrombi, right atrial thrombi, spontaneous echo contrast.
8. **Echo findings with altered electrical activation**: Normal and abnormal depolarization and conduction of the cardiac impulse, bundle branch blocks and Wolf-Parkinson-White syndrome, ectopic rhythm-ventricular and supra-ventricular, pacemakers.
9. **Recent developments in echocardiography in myocardial, pericardial, aortic and systemic disorders**
10. **Infective endocarditis.**

Candidate would be allocated one or two patients/cases who are diagnosed with above conditions, once in a two week. They will be allowed to formulate the diagnostic question independently. The candidate will be analyzed by the faculty for the performance on the basis of diagnostic skill with the interpretation of the disease and looked for the knowledge on treatment modality. This will be followed by the brief discussion.

Textbooks and Reference Books:

1. Echocardiography by Feigenbaum (Latest Edition)
2. Echo manuals by Mayo Clinic Lecture notes.
3. Journal articles Cardiology by Braunwald and Hurst (Latest edition)

Clinical lab posting: 75 hours

Students will be posted in the echocardiographic laboratory for the observation and to develop practice in the echocardiographic examination in myocardial, pericardial, aortic and systemic disorders.

Hands on practical work: 25hours

Students will be allowed to perform echocardiographic test independently under the supervision of the faculty to develop the skill and experience.

Paper- VII- Recent advances 125Hrs

25 Hours

1. **Tissue Doppler(TDI) and Deformation Imaging**
   Technical Principles of Tissue velocity, strain and strain rate imaging Introduction
   Tissue velocity imaging
   Pulsed wave tissue velocity imaging
   Color tissue velocity imaging Curved anatomical M-mode Concepts of strain and strain rate Definition of strain and Strain rate
   Estimation of strain and strain rate from ultrasound data
   Artifacts and methods to improve signal quality
2. **Principles and different technique for speckle tracking**
   Introduction
   Principles of speckle tracking Strain and strain rate assessment Torsion and twist
3. **Application of echocardiography in hemodynamic evaluation**
   Assessment of filling pressure at rest
   Heart failure and LV filling pressure
   Role of standard Echocardiography in Assessment of LV filling pressure Mitral inflow, Pulmonary venous flow
   Colour M-mode flow propagation velocity
   Role of TDI in Assessment of LV filling pressure
   Doppler estimation of LV filling pressure in AF
4. **Assessment of LV filling pressure with strain**
5. **Assessment of Systolic Heart failure**
   Introduction
   Regional systolic and long axis function
   Assessment of LV filling pressure
   Tissue Doppler imaging in heart failure with MR
   Tricuspid annular Velocities and RV function
6. **Assessment of Diastolic Heart failure**
   Introduction
   Differential diagnosis in a patient with Heart failure and Ejection fraction
   Echocardiography as a tool for Assessment of heart failure
7. **Assessment of cardiac dyssynchrony and its application**
   Introduction
   Methods of Assessment of cardiac dyssynchrony by myocardial imaging RV pacing -induced systolic dyssynchrony
   Role of cardiac dyssynchrony, Assessment in cardiac resynchronization therapy: Tissue Doppler imaging

8. **Ischemic heart disease**

   Experimental study on myocardial ischemia and viability using tissue Doppler and deformation

9. **Use of tissue velocity imaging during stress echocardiography**
10. **Tissue Doppler echocardiography in the assessment of Hypertensive heart disease**
11. **Constrictive Pericarditis versus Restrictive cardiomyopathy**
12. **Use of Myocardial imaging to identify and manage sub clinical heart disease in thyroid and other endocrine heart disease**
13. **Myocardial imaging in valvular heart disease** Myocardial imaging in mitral valve disease Myocardial imaging in Aortic valve disease
14. **Tissue Doppler Imaging and strain rate imaging to evaluate RV function.**
15. **3 D Echocardiography** Principles & Clinical Application
16. **Automated Functional Imaging**
17. **3D TEE**

    Clinical Applications & Instrumentation
18. **Cardiac resynchronization therapy**
19. **Contrast Echocardiography**
20. **Fetal Echocardiography.**

Candidates will be trained by the faculty in the echocardiographic lab to obtain technical skill on recent indices of Tissue Doppler imaging including strain and strain rate measurement. Periodically one or two hours per month, candidates will be subjected to random cases for which, the assessment will be carried out by applying all the Deformation techniques under the supervision of the faculty and then the appropriate discussion is recruited to reduce the means of error in the analysis.

Clinical lab posting: 75 hours

Students will be posted in the echocardiographic laboratory for the observation and to develop practice in the echocardiographic examination for diagnosing subtle changes in the myocardium in systemic, valvular, congenital heart diseases. Observing the echo guided CRT analysis to understand the prognostication and to identify the responders.

Hands on practical work: 25hours

Students will be allowed to perform echocardiographic test independently under the supervision of the faculty to develop the skill and experience

Section-III

Minimum requirement of infrastructure, laboratory facilities and staff:

(i) Basic Infrastructure:

Institute should have its own hospital with full-fledged cardiology unit with the following facilities:

- 25 bedded cardiology / cardiac surgery services
- Echocardiography laboratory with 4 echocardiography machines
- Class room with capacity for 30 students, measuring 500 sq.ft
- One departmental Seminar room measuring 250sq.ft for each branch with A.V aids – OHP, Slide projector and computer with accessories are compulsory. LCD Projector (optional) other infrastructure criteria- Principals room, students common room, staff room, Library, office room, Store room, preparation room etc will be as per minimum criteria. Norms of B.Sc-Cardio vascular/Cardiac Care Technology course.

(ii). Infrastructure subject wise

- Anatomy laboratory
- Physiology laboratory
- Echocardiography equipments
  i. Echocardiography machines – 4
  ii. Transoesophageal echocardiography probes –01
  iii. OPD case load for echocardiography – 50 / day
  iv. Cardiology OPD attendance – 100 / day
  v. Cardiology inpatient service minimum – 25 beds
  vi. Cardiac surgical case load – 01operations / day

Suggested Readings:

1. Feigenbaum Present / Latest edition
2. 'Otto' Text book of Echo 6th edition
3. Echo manual – Joe
4. Indian Text book of Echocardiograpy: Amuthan . V
5. Jaypee publishers : Text book of Echo : Navin C Nanda
6. 3D Echo : Dr Amuthan . V
7. Valvular Heart Disease : Dalen & Alpert
8. 'Otto' : 3 D TEE Primer
9. Echocardiography review Guide "Otto"
10. Atlas of 3 D Echo: Edward A. Gill
11. 3 D Echo: Takakhiro Shiota

SECTION- IV
MONITORING LEARNING PROGRESS

It is essential to monitor the learning progress of each candidate through continuous appraisal and regular assessment. It not only also helps teachers to evaluate students, but also students to evaluate themselves. The monitoring be done by the staff of the department based on participation of students in various teaching / learning activities. It may be structured and assessment be done using checklists that assess various aspects. Model Checklists are given in this Chapter, which may be copied and used.

The learning out comes to be assessed should include:

i) ***Acquisition of Knowledge***: The methods used comprise of `Log Book' which records participation in various teaching / learning activities by the students. The number of activities attended and the number in which presentations are made are to be recorded. The logbook should periodically be validated by the supervisors. Some of the activities are listed. The list is not complete. Institutions may include additional activities, if so, desired.

Journal Review Meeting (Journal Club): The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting using a checklist (see Model Checklist – I, Section IV)

Seminars / Symposia: The topics should be assigned to the student well in advance to facilitate in depth study. The ability to do literature search, in depth study, presentation skills and use of audio- visual aids are to be assessed using a checklist (see Model Checklist-II, Section IV)

ii) Teaching skills: Candidates should be encouraged to teach undergraduate medical students and paramedical students, if any. This performance should be based on assessment by the faculty members of the department and from feedback from the undergraduate students (See Model checklist III, Section IV)

iii) Dissertation: Please see checklist IV and V in Section IV.

iv) Work diary / Log Book- Every candidate shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal,
reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of experiments or laboratory procedures, if any conducted by the candidate.

v) *Records:* Records, log books and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University.

<u>Log book:</u>

The logbook is a record of the important activities of the candidates during his training; Internal assessment should be based on the evaluation of the logbook. Collectively, logbooks are a tool for the evaluation of the training programme of the institution by external agencies. The record includes academic activities as well as the presentations and procedures carried out by the candidate.

Format for the logbook for the different activities is given in Tables 1 and 2 of Section IV.
Copies may be made and used by the institutions.

Procedure for defaulters: Every department should have a committee to review such situations. The defaulting candidate is counseled by the guide and head of the department. In extreme cases of default the departmental committee may recommend that defaulting candidate be withheld from appearing the examination, if she/he fails to fulfill the requirements in spite of being given adequate chances to set himself or herself right. **Format of Model Checklists**

Checklist - I

Model Checklist for Evaluation of Journal Review Presentations

Name of the student:_____ Date:_____

Name of the faculty/ Observer:_____

Sl No.	Items for observation during presentation	Poor	Below average	Average	Good	Very Good
		0	1	2	3	4
1	Article chosen was					
2	Extent of understanding of scope & objectives of the paper by the candidate					
3	Whether cross- references have been consulted					
4	Whether other relevant references have been consulted					
5	Ability to respond to questions on the paper /subject					
6	Audio-visuals aids used					
7	Ability to defend the paper					
8	Clarity of presentation					
9	Any other observation					
	Total score					

Checklist - II

Model Check List for the Evaluation of the Seminar Presentations

Name of the student:_____Date:_____

Name of the faculty/ Observer:_____

Sl No.	Items for observation during presentation	Poor	Below average	Average	Good	Very Good
		0	1	2	3	4
1	Article chosen was					
2	Extent of understanding of scope & objectives of the paper by the candidate					
3	Whether cross- references have been consulted					
4	Whether other relevant references have been consulted					
5	Ability to respond to questions on the paper /subject					
6	Audio-visuals aids used					
7	Ability to defend the paper					
8	Clarity of presentation					
9	Any other observation					
	Total score					

Checklist – III

Model Check list for Evaluation of Teaching Skill

Name of the student:_____Date:_____

Name of the faculty/ Observer:_____

SL. No.		Strong Point	Weak point
1	Communication of the purpose of the talk		
2	Evokes audience interest in the subject		
3	The introduction		
4	The sequence of ideas		
5	The use of practical examples and /or illustrations		
6	Speaking style (enjoyable, monotonous, etc., specify)		
7	Summary of the main points at the end		
8	Ask questions		
9	Answer questions asked by the audience		
10	Rapport of speaker with his audience		
11	Effectiveness of the talk		
12	Uses of AV aids appropriately		

Checklist - IV

Model Check list for Dissertation / Project Work Presentations

Name of the student:_____ Date:_____

Name of the faculty/ Observer:_____

Sl No.	Points to be considered	Poor	Below average	Average	Good	Very Good
		0	1	2	3	4
1	Interest shown in selecting topic					
2	Appropriate review					
3	Discussion with guide and other faculty					
4	Quality of protocol					
5	Preparation of proforma					
	Total score					

Checklist – V

Continuous Evaluation of dissertation / project work By
Guide/ Co-Guide
Name of the student: _____Date:_____
Name of the faculty/ Observer:_____

Sl No.	Items for observation during presentation	Poor	Below average	Average	Good	Very Good
		0	1	2	3	4
1	Periodic consultation with guide/ co-guide					
2	Depth of Analysis/ Discussion					
3	Department presentation of findings					
4	Quality of final output					
5	Others					

	Total score					

Overall Assessment Sheet

Date:

Check list No.	**Name of the students**			
	A	**B**	**C**	**D**
1				
2				
3				

Course i/c **Signature of the HOD** **Signature of the Prof. i/c AHS**

The above overall assessment sheet used along with logbook should form the basis for certifying satisfactory completion of course of study, in addition to the attendance requirement.
KEY

Mean score: Is the sum all the scores of checklists 1 to 5

A, B, C: Name of the students

LOG BOOK

Table 1: Academic activities attended

Name:

Admission Year:

Date	**Type of activity, Specific Seminar, Journal club, presentation, UG teaching**	**Particulars**

LOG BOOK

Table-2: Academic presentations made by the student

Name:

Admission Year:

Date	**Topic**	**Type of activity, Specific Seminar, Journal club, presentation and UG teaching**

Management Information System Report

1. Name of the college imparting Echocardiography
2. Details of M.Sc.

Sl. No	**Name of the Branch & Teaching faculty**	**Sanctioned Strength**	**Admitted**	**Name of the subjects to be studied at 1st Year M.Sc.**	
1					
2					

3. No. of experiments/assignments conducted for 1st year M.Sc. Echocardiography students

Sl.No	**Branch**	**Subject**		**Assigned by SVIMS University**	**Conducted**	**%**	**Remarks**
1.		**No**	**Name**				
2							

4. No. of theory classes conducted for 1st year M.Sc. Echocardiography students

Sl.No	Branch	Subject		SVIMS University Norms(25)	Conducted	%	Remarks
1.		**No**	**Name**				
2.							
3.							

5. Number of theory and practical classes taken by 2nd year M.Sc. Echocardiography students for under graduate program (Optional).
6. No. of Journal clubs department wise for 1st year and 2nd year M.Sc. Echocardiography Students

Total No. of students Dept. Wise	Norms for half yearly Report	Achieved Number	% Achievement	Remarks
1st year M.Sc. Echocardiography No.=	2 per candidate per year			
2nd year M.Sc. Echocardiography No.=	2 per candidate per year			

7. Number of seminars for 1st year and 2nd year M.Sc. Echocardiography students

Total No. of students : 10	Norms for half yearly Report	Achieved Number	% Achievement	Remarks
1st year M.Sc. Echocardiography No.=10	2 per candidate			
2nd year M.Sc. Echocardiography No.= 08	2 per candidate			

8. Number of interdepartmental meetings

Norms for half yearly Report	Achieved Number	% Achievement	Remarks
	2	200%	Interactive and productive

9. Number of visits to pharmaceutical industry/research center/hospital for 1st year & 2nd year M.Sc. Echocardiography students.

Norms for half yearly Report	Achieved Number	% Achievement	Remarks
1	02	200	Educative & informative

10 Number of guest lectures for postgraduate Program

Norms for half yearly Report	Achieved Number	% Achievement	Remarks
2	03	150	Need focused and educative

11. Number of research papers published in the year in the college –

12. Any other additional information such as consultancy/collaboration/conducting Seminars & workshop or attending seminar & workshops or conference

Sl. No.	Subject	No. of Contact Hours	Code	Grade	Remarks
1.	Cardiac Embryology	20	C,L	P	
2.	Fetal and neonatal circulation	2	C,L	P	
3.	Ultrasound physics and instrumentation	146	C,L,P,PL	P	
4.	Clinical Cardiology	133	C,L,PL	P	
5.	Cardiovascular Pharmacology	10	C,L	P	
6.	Electrophysiology	4	C,L	P	
7.	Acute coronary syndrome	8	C,L	P	
8.	BLS/ACLS	10	C,L,P	P	
9.	Ischemic Heart Disease	17	L	P	
10.	Valvular Heart disease	32	L	P	
11.	Congenital Heart Disease	44	L	P	
12.	Cardiac surgery	10	L,C, PL	P	
13.	Echocardiography for lschemic Heart disease	70	C,P,PL	P	

14.	Echocardiography for Valvular heart disease	70	C,PL,P	P	
15.	Echocardiography for Congenital Heart disease	140	C,PL,P	P	
16.	Epedemiology and Biostastics	60	L	P	
18.	Ehocardiography of other heart diseases	25	PL, C,L,P	P	
19.	Myopericardial, Aortic, Systemic disorder & non cardiac diagnosis	137	C,L,P,PL	P	
20.	Recent Advances	168	C,L,PL,P	P	
21	Medical ethics	10	L	P	
22	Fetal Echocardiography	2	L,P	P	
23	Peripheral Ultrasound	2	L,P	P	
24	Seminar presentation	SS, I(G)	Classes for UG's		
25	Attending rounds with Cardiologists	10	C	P	

DESCRIPTION OF CODES

C : Clinical Teaching

D : Demonstration of Faculty

I : Independent Work by Student

I (G) : Independent Work by Student Guided by Faculty

L : Classroom Lectures by Faculty

P : Hands on Practical Work by Students

SD : Self Directed Study by Student

SD (E) : Self Directed Study by Student with Faculty Evaluation

SS : Student Conducted Seminars with Faculty Moderation and Evaluation by Peers and Faculty

PL : Practical / Clinical Lab Posting

Prof. & Course Incharge **Prof.& HOD** **Prof. i/c AHS**

CHECKLIST - I

Model Check List for Evaluation of Teaching Skill

SL. No.		Poor 0	Below average 1	Average 2	Good 3	Very good 4
1	Communication of the purpose of the talk					
2	Evokes audience interest in the subject					
3	The introduction					
4	The sequence of ideas					
5	The use of practical examples and /or illustrations					
6	Speaking style (enjoyable, monotonous, etc., specify)					
7	Summary of the main points at the end					
8	Ask questions					
9	Answer questions asked by the audience					
10	Rapport of speaker with his audience					
11	Effectiveness of the talk					
12	Uses of AV aids appropriately					

CHECKLIST - II

Model check list for Dissertation / Project Work Presentations

S. No.	Points to be considered	Poor 0	Below average 1	Average 2	Good 3	Very Good 4
1	Interest shown in selecting topic					
2	Appropriate review					
3	Discussion with guide and other faculty					
4	Quality of protocol					
5	Preparation of proforma					
	Total score					

Overall Assessment of the student by the clinical/Lab work:

Sl. No	Points to be considered	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4	Excel lent 5
1	Attendance						
2	Punctuality						
3	Interaction with colleagues and support staff						
4	Maintenance of case records						
5	Topic Presentation						
7	Time sense						
8	Knowledge						
9	Rapport with patient.						
10	Overall quality of work						
	Total Score	- -	- -	- -			

MODEL QUESTION PAPER

THEORY

Each theory paper will have

1) Essay questions – 03 nos. carrying 10 marks each - 03 x 10 = 30
2) Short answer questions – 10 nos. carrying 05 marks each - 10 x 05 = 50

Total = 80

Internal assessment = 20

PRACTICAL

(a) Preliminary:

Internal assessment : 15

University examination : 60

Total = 75

(b) Viva = 25