Diploma of Medical Ultrasonography (DMU) (Cardiac)

Syllabus
INTRODUCTION

This syllabus is divided into two parts. Part 1 forms the foundation for Part 2. Part 2 continues with the acquisition of knowledge and concentrates on the acquisition of skills.

i. Philosophy/Perspective
Diagnostic ultrasound is firmly established in medical practice. Ultrasound facilitates decisions regarding patient management and the sonographer plays a significant role in the diagnostic team. The training and assessment processes need to reflect the responsibilities required of the sonographer.

ii. Theory And Training
As health care professionals, the sonographer’s role is to perform imaging to a high standard and to provide accurate information to aid in the correct management of the patient. Vital to the performance of a high standard of practice are several factors including:

- The assimilation of factual knowledge and understanding of relevant physical principles of ultrasound, instrumentation, anatomy, physiology, pathology and, where applicable, therapeutic intervention
- Acquisition and understanding of the required technical skills
- Acquisition and appropriate use of high-level oral and written communication skills
- Acquisition of interpersonal skills necessary for the sonographer to function in a professional, competent, caring and compassionate manner

Clinical supervision is provided by the practice in which the sonographer is working. It is recognised that some trainees may not be exposed to the broad range of ultrasound applications in one institution. Where there are local limitations, experience should be sought elsewhere. Participation in day-to-day reporting, clinical conferences and scientific meetings is advised. Emphasis is placed on current knowledge and skills. A commitment to continuing education is a professional responsibility.

iii. Responsibilities
In the delivery of a high quality professional service the responsibilities of the sonographer include:

- Clear communication with the patient and other medical staff
- Preparation of the patient for the examination
- An ability to obtain informed consent
- Confidentiality with patient information
- Care and comfort of the patient during the examination
- Familiarity with emergency procedures
- Strict adherence to infection control practice and knowledge of current standards
- Safe work practices in accordance with current standards of occupational health and safety considerations
- Knowledge of bioeffects
- Care and maintenance of equipment
- Acquisition of appropriate information to be presented to the medical practitioner for consideration and reporting
- Awareness of professional, legal and ethical aspects of sonographic practice
- Sensitivity to cultural differences
- Quality control of equipment and practical and administrative details
- A commitment to continuing education

ASUM policies, statements and clinical protocols are applicable where appropriate in the above points.
iv. Overview Of The DMU (Cardiac)

The DMU (Cardiac) is designed to assess the candidate’s knowledge and competencies in:

- Two-dimensional (2D) and motion mode (M-mode) techniques of the normal and abnormal adult heart, including measurements, haemodynamic evaluation and limitations
- Spectral (including DTI – Doppler Tissue Imaging) and colour Doppler techniques of the normal and abnormal heart, including qualitative and quantitative haemodynamic evaluation, measurements and limitations.

In order to achieve and demonstrate these skills, the sonographer must:

- Have knowledge of normal and abnormal cardiac anatomy, including gross anatomy, spatial relations, related vasculature, cross-sectional anatomy, cardiac embryology and maldevelopment of the human heart
- Have knowledge and understanding of cardiovascular physiology, including haemodynamics, electrocardiography and the conduction system, and basic cardiac pharmacology
- Have knowledge and understanding of cardiac pathology and pathophysiology in a wide range of acquired and congenital heart disease
- Have knowledge of cardiac surgical and interventional procedures, including valve replacement and repair, coronary artery bypass grafting, congenital surgical repair and balloon valvuloplasty
- Have a demonstrated knowledge of the clinical details and associated sonographic findings as per clinical requests for an echocardiogram
- Have knowledge of theoretical and applied physical principles of ultrasound and instrumentation
- Have knowledge of theoretical and applied principles of Doppler ultrasound and instrumentation
- Be able to demonstrate appropriate scanning techniques and acquisition of sonographic information, including appropriate measurements and limitations of these measurements
- Be able to interpret sonographic findings with an analytical and critical approach
- Be able to present sonographic images in a logical and methodical manner

In addition, cardiac sonographers are required to have a basic knowledge and understanding of the clinical indications, technique and limitations of:

- Other echocardiographic modalities such as stress echocardiography, transoesophageal echocardiography, intraoperative echocardiography and paediatric echocardiography
- New and evolving technologies such as contrast echocardiography, intravascular techniques, 3D echocardiography
- Complementary diagnostic cardiac procedures, including cardiac catheterization, ECG, Stress ECG, plain X-ray, CT, MRI, and radionuclide imaging

The DMU (Cardiac) is also designed to assess the candidate’s knowledge of other important aspects of sonographic practice such as:

- Professional, legal and ethical aspects of sonographic practice
- Quality control principles and practices
- Safe work principles and practices
PART 1 DMU (CARDIAC) SYLLABUS

a. Cardiac And Related Anatomy
Within this area, candidates are required to have knowledge of the following:

- Basic anatomical terminology and body regions
- Cardiac size, shape and external features including:
  - position of the heart within the thorax
  - cardiac surfaces and sulci
  - cardiac base, apex, surfaces and borders
  - cardiac valve relations and surface anatomy
  - fibrous skeleton
  - motion of heart during the cardiac cycle
- Anatomy of the cardiac chambers and related septa, including:
  - right atrium
  - left atrium
  - interatrial septum
  - left ventricle
  - right ventricle
  - interventricular septum
- Anatomy of valves and related apparatus including:
  - structure and function of the atrioventricular valves:
    - tricuspid valve and supporting apparatus
    - mitral valve and supporting apparatus
  - structure and function of the semilunar valves:
    - aortic valve
    - pulmonary valve
- Arterial and venous systems including:
  - structure of blood vessels
  - function of arteries and veins
  - aorta: segments and branches
  - pulmonary trunk
  - coronary arteries (origin, distribution and function)
  - cardiac veins (distribution, drainage and function)
  - superior vena cava
  - inferior vena cava
- Conduction system of the heart including the location and function of:
  - sinoatrial (SA) node
  - internodal (interatrial) pathways
  - atrioventricular (AV) node
  - Bundle of His
  - Bundle branches
  - Purkinji fibres
- Layers of the heart:
  - pericardium
  - epicardium
  - myocardium
  - endocardium

Cardiac muscle structure
• Innervation of the heart and vessels including:
  o sympathetic fibres
  o parasympathetic fibres
  o sensory fibres

b. Cardiac Embryology
Within this area, candidates are required to have a basic knowledge of the following:
• Embryological development and formation of the cardiovascular system, including:
  o primitive vascular tube
  o sinus venosus
  o cardiac loop
  o cardiac septa
  o atrioventricular and semilunar valves
  o the aortic arch system
  o the systemic venous system
  o adult derivatives of fetal structures

• Fetal and neonatal circulations:
  o fetal circulation
  o circulation changes at birth (including mechanisms for changes)

• Abnormalities of development, including abnormalities of the following:
  o cardiac septation
  o the atrioventricular canal
  o atrioventricular and semilunar valves
  o the truncus and conus
  o the great arteries
  o venous drainage
  o persistent fetal circulation

c. Cardiac Physiology
Within this area, candidates are required to have knowledge of the following:
• Electrophysiology of the Heart including:
  o the conduction system
  o action potentials and excitation-contraction coupling

• The Electrocardiogram including:
  o the normal 12 lead electrocardiogram (ECG)
  o abnormalities of the ECG complex
  o abnormalities of rhythm
  o abnormal conduction
  o pre-excitation syndromes
  o cardiac pacemakers

• Mechanical events including:
  o Frank-Starling Law
  o Valve motion and the relationship of motion to the cardiac cycle

• Phases of the Cardiac Cycle including:
  o atrial systole
  o isovolumic contraction
  o ventricular ejection
  o isovolumic relaxation
  o passive filling phase
o diastasis
  o relationship between these phases and electrical and mechanical events
• Cardiac Output and its Control including:
  o definition of cardiac output
  o methods of calculating the cardiac output
  o control of cardiac output
  o factors affecting cardiac output

• Intracardiac pressures and pressure waveforms including:
  o normal intracardiac pressures
  o pressure waveforms as seen at cardiac catheterisation

• Systemic versus pulmonary circulation including:
  o components of these circulations
  o pressures within each circulation
  o oxygen saturations within each circulation

• Coronary circulation, including:
  o coronary artery circulation
  o coronary venous return

• Variables that alter cardiac physiology including:
  o exercise
  o positional changes
  o respiration
  o Valsalva manoeuvre

• Cardiac auscultation including:
  o sites for auscultation
  o mechanism and timing of the:
    → first heart sound (S1)
    → second heart sound (S2)
    → third heart sound (S3)
    → fourth heart sound (S4)

d. PATHOLOGY
Within this area, candidates are required to have knowledge of the following:
• Basic concepts of general pathology including:
  o cell injury and adaptation
  o inflammation and repair
  o fluid and haemodynamic derangements
  o atherosclerosis, thrombosis, embolism and infarction
  o genetic disorders
  o disorders of immunity
  o neoplasia

• Symptoms of cardiac disease processes including:
  o dyspnoea
  o chest pain
  o syncope/
  o presyncope
  o fever

• Physical signs of cardiac disease processes including:
o clubbing
o cyanosis (peripheral versus central)
o oedema
o abnormal heart sounds and heart murmurs (including causes)
o elevation of the JVP

- Cardiac diseases and disease processes including a basic knowledge of the aetiology, pathophysiology, clinical findings and complications of the following cardiac diseases (NOTE: candidates are expected to acquire a basic knowledge of these areas, as a more in depth knowledge will be required for the DMU( Cardiac) Part 2 syllabus):
  o ischaemic heart disease
  o valvular heart disease
  o diseases of the aorta
  o cardiomyopathies (hypertrophic, restrictive and dilated)
  o pericardial disease
  o systemic and pulmonary hypertension
  o cardiac tumours
  o infective endocarditis

- Cardiac Disease due to systemic illness including a basic knowledge of the disease process and the associated cardiac involvement of the following systemic diseases:
  o rheumatic disease
  o systemic lupus erythematosus
  o amyloidosis
  o sarcoidosis
  o carcinoid disease

- Congenital heart disease including a basic knowledge of the definition and diagnostic criteria, embryological maldevelopment, pathophysiology and associated cardiac lesions of the following:
  o valvar, subvalvar and supravalvar stenosis
  o atrial septal defects (secundum, primum, sinus venosus, coronary sinus)
  o ventricular septal defects (membranous, muscular)
  o endocardial cushion defect (A-V canal defect)
  o patent ductus arteriosus
  o coarctation of the aorta
  o Ebstein’s anomaly
  o Tetralogy of Fallot
  o Eisenmenger’s syndrome
  o transposition of the great arteries (dextro versus levo)
  o truncus arteriosus
  o anomalous pulmonary venous drainage (total and partial)

- A basic knowledge of the definition of the echocardiographic presentation of syndromes commonly associated with congenital heart disease (including associated congenital heart lesions) such as:
  o DiGeorge sequence (e.g. aortic arch anomalies)
  o Down syndrome (e.g. atroventricular canal defect, VSD, Tetralogy of Fallot)
  o Ehlers-Danlos syndrome (e.g. aortic root dilatation, mitral and tricuspid valve prolapse)
  o fetal rubella syndrome (e.g. patent ductus arteriosus)
  o Friedreich’s ataxia (e.g. cardiomyopathy)
  o Goldenhar syndrome (e.g. ventricular septal defect)
e. Cardiac Pharmacology
Within this area, candidates are required to have a basic knowledge of the types, principal actions and major indications of the following cardiovascular drugs:

- inotropic / chronotropic drugs
- antiarrhythmic drugs
- antihypertensive drugs
- antianginal agents / vasodilators
- anticoagulant, thrombolytic, lipid-lowering and antiplatelet drugs
- diuretics
- drugs used to maintain/close a patent ductus arteriosus (PDA)

NOTE: It is each candidate’s responsibility to ensure that they have covered all the areas in this syllabus.

PART 2 DMU (CARDIAC) SYLLABUS

a. Technique: General Considerations
The sonographer will be expected to attain competence in the performance and interpretation of diagnostic ultrasound examinations. Along with a review of relevant Part I material, emphasis will be placed on application of this knowledge and its integration with the development of technical skills, image interpretation and patient care. This will involve reviewing anatomy and pathology and understanding the technical requirements necessary to produce ultrasound images that display normal and abnormal anatomy. For any examination, the sonographer will be expected to:

- Understand the clinical indication for the examination
- Assess the suitability of ultrasound to answer a particular question and recognise any limitations presented by:
  - patient condition/habitus
  - equipment available
  - personal skills
- Explain the procedure to the patient
- Be aware of the needs of the patient during the examination and maintain a good level of communication with the patient throughout the procedure to ensure that patient needs are met throughout the procedure
- Select the appropriate ECG lead and ensure correct ECG lead placement (lead II should routinely be used).
- Optimisation of the ECG signal throughout the echocardiogram (showing an upright P wave) to ensure correct digital capture occurs
- Select appropriate transducer and transducer frequency
- Optimise technical factors in order to obtain best possible image quality
- Recognise artifacts and their causes
- Optimise image controls to preserve and enhance image detail
- Systematically survey cardiac and adjacent structures with attention to:
  - chamber and great vessel dimensions
- Recognise and describe the sonographic appearances of normal anatomy, physiology and pathology
- Perform relevant and pertinent 2-D, M-mode and Doppler measurements
- Extend the examination to other areas as may be indicated by findings during the examination
- Select suitable images to record relevant anatomy and pathology
- Record M-mode, two dimensional and Doppler studies ensuring that an appropriate number of images are recorded to fully demonstrate all normal and abnormal anatomy and haemodynamic information
- Demonstrate a high level of proficiency in the use of the non-imaging CW Doppler probe (Pedoff probe). This includes the correct and appropriate use and application of this probe, the advantages of using this probe, and the limitations of this probe.
- Understand clinical measurements in common usage in echocardiography
- Be aware of specialised imaging techniques relevant to echocardiography, e.g. transoesophageal, stress echo, contrast echo
- Present, explain and discuss the sonographic information for reporting
- Comply with ASUM’s “Policy on Ultrasound Safety”
- Label recorded images appropriately
- Use equipment safely

b. Techniques
Within this area, candidates are required to have a detailed knowledge of the:
- 2-D Examination including:
  o acoustic windows (both standard and additional acoustic windows, so as to ensure that all pathology is fully demonstrated and interrogated)
  o imaging planes and knowledge of the structures visualized in each echocardiographic view
  o echocardiographic views including patient position, transducer position and rotation, image orientation, structures identified
  o optimisation of 2D imaging controls (including frequency, depth, zoom functions, pre-processing, overall gain, TGC, dynamic range, persistence, edge enhancement, post-processing, B-colour in 2D imaging)
  o 2D imaging artifacts (aetiology, echocardiographic appearance, principles of physics of how and why the artifact occurs, techniques used to correct/avoid the artifact)
  o M-mode measurement methodology
  o structures interrogated including imaging plane, cursor position, structures transected, motion of structures throughout the cardiac cycle
  o advantages and disadvantages of M-mode imaging as compared to 2D imaging
  o Spectral Doppler examination including imaging planes, normal spectral display, spectral Doppler machine controls
  o optimisation of Spectral Doppler machine controls (including gain, velocity scale, baseline, filters, sweep speed, sample volume position, sample volume size)
  o Pulse-wave (PW) Doppler versus Continuous-wave (CW) Doppler, including the application of PW and CW
- Doppler in cardiac pathology:
  o Spectral Doppler presentations of cardiac pathology
c. Doppler Haemodynamic Assessment: Principles, Formulae and Calculations

Within this area, candidates are required to have knowledge of the:

- **Principles of Blood Flow** including:
  - characteristics of blood flow
  - properties of blood
  - factors that affect blood flow
  - types of blood flow (laminar flow, turbulent flow)

- **Principles of the Doppler Effect** including:
  - The Doppler effect
  - The Doppler equation (including each component of this equation)

- **Pressure Gradient Calculations** including:
  - simplified Bernoulli equation (including understanding the components of the Bernoulli equation, the assumptions of the simplified Bernoulli equation, when the Bernoulli equation needs to be modified)
  - maximum instantaneous pressure gradients
  - mean pressure gradients
  - limitations of pressure gradient calculations

- **Volume Flow Calculations** including:
  - stroke volume calculations
  - cardiac output calculations
  - QP:QS Shunt calculations
  - limitations to volume flow calculations

- **Valve Area Calculations** including:
  - pressure half-time and deceleration time methods
  - continuity equation method (assumptions of the continuity equation, applications and limitations)
  - proximal isovelocity surface area (PISA) method
  - limitations of valve area calculations

- **Regurgitation Quantification** including:
  - regurgitant volumes and Regurgitant fractions, effective Regurgitant orifice area
  - Proximal isovelocity surface area (PISA) method
  - vena-contracta technique for the assessment of the severity of regurgitant lesions
  - jet height/LVOT height ratio in the assessment of the severity of aortic regurgitation
  - jet area ratios
  - limitations to these methods

- **Intracardiac Pressure Calculations** including estimation of:
  - right ventricular and pulmonary systolic pressure
  - pulmonary artery end-diastolic pressure
  - pulmonary artery mean pressure
  - right atrial pressure (2D imaging of the IVC)
  - left ventricular end-diastolic pressure
  - left atrial pressure

- **Limitations of Doppler techniques in the estimation of intracardiac pressures**

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d. Assessment of Left Ventricular Function
Within this area, candidates are required to have knowledge of the:

- **Assessment of Left Ventricular Systolic Function:**
  - M-Mode methods and relevant formulae
  - Two-dimensional (2-D) methods and relevant formulae, including the modified Simpson’s Biplane method of quantitating LV size and LV systolic function
  - Doppler methods and relevant formulae
  - Limitations of 2D, M-mode and Doppler methods

**NOTE:** a candidate must demonstrate an understanding and correct application of the reference ranges for normal and abnormal cardiac chamber sizes (including referenced to patient height and body surface area) and LV systolic function, as per the American Society of Echocardiography (ASE) recommendations (see Part 2 references). Candidates must be aware of, and understand the current ASE recommendations for chamber quantification.

- **Assessment of Left Ventricular Diastolic Function including:**
  - Clinical indications for diastolic function assessment
  - M-mode indicators of increased LV end-diastolic pressure
  - Colour M-mode use in the assessment of LV diastolic function, particularly in the assessment of pseudonormal diastolic dysfunction
  - Doppler techniques used in assessing diastolic function
  - Doppler Tissue Imaging (DTI or TDI) use in the assessment of LV diastolic function, including applications, normal ranges, identification of abnormal values, use of DTI in constriction, limitations of DTI
  - Abnormal diastolic filling profiles
  - Significance of left ventricular systolic function and patient sex and age in the assessment of diastolic function
  - Limitations of M-mode and Doppler assessment of left ventricular diastolic function

### e. Chamber Quantification

It is expected that candidates will refer to the American Society of Echocardiography with regards to chamber quantification and right heart assessment. For this section of the syllabus refer to the recommended reading list.

Within this area, candidates are required to have a detailed and thorough knowledge of:

- **Assessment of Left Ventricular chamber size and wall thickness**
  - M-mode and 2D measurements (including Simpson’s biplane volumes)
  - Applications and limitations of these techniques
  - Reference ranges for normal and abnormal Left Ventricular size, including correction for body surface area (BSA), height and gender for both M-mode and 2D methods (including Simpson’s biplane volumes)
  - Calculation of Left ventricular mass from Left Ventricular M-mode measurements, including reference ranges for normal and abnormal Left Ventricular wall thickness
  - Assessment of Right Ventricular size and wall thickness
  - M-mode and 2D methods (basal, mid-cavity and longitudinal dimensions as measured from the Apical 4 chamber view).
  - Applications and limitations of these techniques
  - Reference ranges for normal and abnormal Right Ventricular size
  - Assessment of Right Ventricular systolic function (example fractional area change, tricuspid annular excursion on 2D imaging, tricuspid annular DTI)
  - Reference ranges for normal and abnormal RV systolic function

- **Assessment of the Left and Right Ventricular outflow tracts (LVOT and RVOT) and great arteries (aorta and pulmonary artery):**
  - 2D measurements of LVOT and RVOT diameters
• applications of the 2D measurements of LVOT and RVOT diameters in interrogation of normal and pathological cardiac haemodynamics
• 2D measurements of the pulmonary artery (PA)
• 2D measurements of the segments of the aorta (Ao) including trans-sinus diameter, sinotubular junction, ascending Ao, descending Ao and aortic arch
• applications of the 2D measurements of the segments of the aorta in normal and pathological situations
• reference ranges for LVOT, RVOT, Ao and PA measurements (including correction of the Aorta for BSA and height)
• limitations of the 2D measurements of the LVOT, RVOT, Ao and PA

• Assessment of the Inferior Vena Cava (IVC)
  • M-mode technique of assessing IVC size and inspiratory response
  • 2D measurement of the IVC from the subcostal short axis view
  • 2D evaluation of the inspiratory response of the IVC in the assessment of right atrial pressure
  • reference ranges for the assessment of IVC size and inspiratory response
  • applications and limitations of these techniques

• Assessment of the Left Atrium (LA) and Right Atrium (RA)
  • M-mode and 2D measurements of the LA size (including LA cross-sectional area and LA biplane volumes)
  • reference ranges for normal and abnormal left atrial size, including correction for body surface area (BSA)
  • 2D measurements of RA size
  • applications and limitations of the measurement of LA and RA size

f. **Ischemic Heart Disease**
   Within this area, candidates are required to have knowledge of:

   • Wall motion abnormalities including:
     • aetiology of regional wall motion abnormalities
     • echocardiographic criteria of wall motion scoring
     • division of the left ventricle into the traditional 16 segment model, and also understanding and knowledge of the new 17 segment model, as per the ASE 2005 recommendations (see Part 2 Reading List for details)
     • echocardiographic planes used to visualise both the 16 and 17 segment models as per the ASE 2005 recommendations (see Part 2 Reading List for details)
       coronary artery supply to the segments of the left ventricle as well as to the right ventricle
     • relationship between coronary artery distribution, ECG leads and echocardiographic views

   • Echocardiographic assessment of the secondary complications of the myocardial infarction including:
     • intraventricular thrombus
     • true ventricular aneurysms
     • false or pseudo ventricular aneurysm
     • papillary muscle dysfunction / rupture
     • ventricular septal rupture
     • right ventricular infarction
     • pericarditis/pericardial effusion

g. **Valvular Heart Disease**
   Within this area, candidates are required to have knowledge of:

   • Native Valve Disease including:
     • aetiology of valve disease
o 2-D, M-mode and Doppler echocardiographic examination, techniques and findings
o semiquantitative and quantitative measurements used in the assessment of severity of valve lesions (including methodology, reference ranges for the quantitation of severity of both stenotic and regurgitant valve disease, limitations and advantages of each technique)
o criteria employed for determining grades of severity of valve lesions - including an understanding of the ASE recommendations for evaluation of the severity of native valvular regurgitation with two dimensional and Doppler Echocardiography (see part II references for details).
o Spectral Doppler indirect signs of significant valvular regurgitation

• Prosthetic Heart Valves including:
o knowledge of the different types of prosthetic valves (mechanical and bioprosthetic)
o understanding the importance of an early post-operative baseline study for prosthetic valves
o understanding the importance of valve position, type and size with regard to normal Doppler values
o 2-D, M-mode and Doppler echocardiographic assessment of prosthetic valves, including artifacts commonly encountered, limitations of transthoracic echocardiography, and the role of transoesophageal echocardiography
o echocardiographic assessment of prosthetic valve dysfunction
o criteria employed for determining normal and abnormal prosthetic valve function as per the ASE guidelines on echocardiographic assessment of prosthetic valves

h. Cardiomyopathies
Within this area, candidates are required to have knowledge of the aetiology, 2-D, M-mode and Doppler echocardiographic examination and findings of:
• Dilated cardiomyopathies
• Hypertrophic cardiomyopathies
• Restrictive/Infiltrative cardiomyopathies

i. Systemic And Pulmonary Hypertensive Heart Disease
Within this area, candidates are required to have knowledge of the aetiology, 2-D, M-mode and Doppler echocardiographic examination and findings of:
• Systemic hypertension
• Pulmonary hypertension

j. Diseases Of The Aorta
• Aortic root dilatation
• Aortic dissection
• Sinus of valsalva aneurysm
• Classification of aortic dissections:
  • DeBakey and Stanford classifications
  • Role of transoesophageal echocardiography in the assessment of aortic dissections

k. Pericardial Disease
Within this area, candidates are required to have knowledge of the aetiologies, 2-D, M-mode and Doppler echocardiographic examination and findings of:
• Pericardial effusion
• Cardiac tamponade
• Constrictive pericarditis
Candidates are also required to have knowledge of the echocardiographic differentiation between pericardial effusions and the following:

- Left pleural effusion
- Epicardial fat pads
- Hiatus hernia
- Descending aortic aneurysm
- Left ventricular pseudoaneurysm

I. Cardiac Masses
Within this area, candidates are required to have knowledge of the types and 2-D, M-mode and Doppler echocardiographic examination, techniques and findings of:

- Cardiac tumours
- Thrombus

Candidates are also required to have knowledge of the types and 2-D, M-mode and Doppler echocardiographic examination, techniques and findings of:

- Endocarditis

Candidates are also required to have knowledge of commonly encountered artifacts, causes of artifacts and the echocardiographic recognition of artifacts.

m. Cardiac Diseases Due to Systemic Illness
Within this area, candidates are required to have knowledge of the basic pathological features, associated with cardiac involvement and the echocardiographic findings of the following systemic diseases:

- Hypereosinophilia
- Connective tissue disorders (Marfans and Ehlers-Danlos)
- Pheochromocytoma
- Rheumatoid arthritis
- Rheumatic fever
- Sarcoidosis
- Systemic lupus erythematosus
- Amyloidosis
- Carcinoid
- Haemochromatosis

n. Congenital Heart Disease
Within this area, candidates are required to have knowledge of the lesions, and the 2-D, M-mode and Doppler echocardiographic examination, techniques and findings of:

- Valvular stenosis
- Atrial septal defects (secundum, primum, sinus venosus, coronary sinus)
- Ventricular septal defects (membraneous, muscular)
- Endocardial cushion defect (A-V canal defect)
- Transposition of the great arteries (dextro versus levo)
- Coarctation of the aorta
- Ebstein's anomaly
- Tetralogy of Fallot
- Eisenmenger's syndrome
- Patent Ductus Arteriosus

Candidates are also required to have knowledge of palliative and corrective surgical procedures such as:

- Fontan
- Mustard
• Pulmonary artery band
• Rastelli
• Senning
• Arterial Switch

Candidates are also required to have knowledge of syndromes commonly associated with congenital heart disease (including associated congenital heart lesions) such as:

• DiGeorge sequence (e.g. aortic arch anomalies)
• Down syndrome (e.g. atrioventricular canal defect)
• Ehlers-Danlos syndrome (e.g. aortic root dilatation)
• Fetal rubella syndrome (e.g. patent ductus arteriosus)
• Friedreich’s ataxia (e.g. cardiomyopathy)
• Goldenhar syndrome (e.g. ventricular septal defect)
• Holt-Oram syndrome (e.g. atrial septal defect)
• Muscular dystrophy (Duchenne type) (e.g. cardiomyopathy)
• Noonan syndrome (e.g. pulmonary valve stenosis)
• Tuberous sclerosis (e.g. rhabdomyomas)
• Turner syndrome (e.g. coarctation of the aorta)
• William syndrome (e.g. supravalvular aortic stenosis)

o. **Other Echocardiographic Modalities**

Within this area, candidates are required to have a basic knowledge of the clinical application of the following imaging techniques, including the indications, contraindications, limitations, advantages, disadvantage, techniques and interpretation of test results for:

• Stress Echocardiography including:
  o exercise Echocardiography;
  o pharmacological (Dobutamine) Stress Echocardiography
  o Transoesophageal Echocardiography

p. **New And Evolving Technologies**

Within this area, candidates are required to have a basic knowledge of the clinical applications of:

• Contrast echocardiography
• Intravascular techniques
• 3D echocardiography
• Fetal echocardiography

q. **Professional, Legal and Ethical Aspects of Sonographic Practice**

The role of the sonographer is diverse and complex and so DMU candidates are required to have an understanding of their responsibilities to the:

• patient
• employer
• regulating bodies

Candidates must also understand and adopt practices that conform to the standards of their profession and have due consideration for the legal and ethical issues which regulate their actions as a health care professional.

Sonographers must be aware of their legal responsibilities and of ethical issues that may occur during their practice as a sonographer. The candidate is expected to have an understanding about a range of legal issues including:

• consent
  → verbal
  → written
→ implied
→ competence to give consent
  o patient confidentiality
  o record keeping
    → maintaining confidentiality
    → storage of records
  o a sonographer’s legal responsibilities

Sonographers must be aware of:
  o published standards of practice
  o the process of sonographer accreditation
  o the value of membership to appropriate professional bodies

The candidate is also expected to have a good knowledge of these workplace issues:
  o workplace health and safety including ergonomics
  o emergency procedures
  o infection control
    → policies
    → procedures
  quality control of equipment
  administrative processes
  indemnity insurance

The candidate must also have an understanding of the following ethical aspects of sonography:
  o basic bioethical principles and how they apply to sonography
  o autonomy
  o non-maleficence
  o beneficence
  o justice
  o veracity
  o how to resolve ethical dilemmas and conflict
  o the relevance of bioethics in the practice of sonography and in particular in:
  obstetrics and gynaecology
  the use of new technologies

In order to be able to critically analyse information and understand their responsibilities you will need to:
  o read widely from relevant publications
  o attend conferences and seminars
  o participate in continuing education programs

**NOTE:** It is each candidate’s responsibility to ensure that they have covered all the areas in this syllabus.