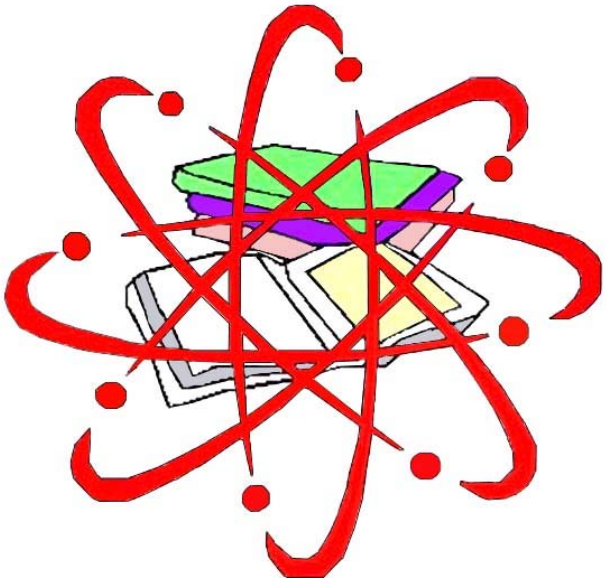
REGIONAL COOPERATIVE AGREEMENT

INTERNATIONAL ATOMIC ENERGY AGENCY

Distance Assisted Training Programme for Nuclear Medicine Technologists



Instructions for Students

2005

INSTRUCTIONS FOR STUDENTS

CONTENT

Distance Assisted Training Programme
for
Nuclear Medicine Technologists

INSTRUCTIONS FOR STUDENTS

This document should be read by all students (nuclear medicine technologists) who are participating in the Distance Assisted Training Programme.

As part of the course of study the student will be required to read the course material, enter data into a Workbook, prepare protocols and discuss them with their supervisor, perform laboratory exercises and complete/return assignments to the National DAT Programme Coordinator. There will be times when the student will need assistance and advice in order to complete these tasks. The content of this document aims to provide you with information on course structure, recommendations on how to study the material and the expectations to qualify for the final certificate.

INTRODUCTION

The aim of this course is to provide a program of distance education so that practising technologists, without formal qualifications, can achieve a higher standard and uniformity of training in nuclear medicine technology. This should enable more effective use of existing nuclear medicine technology and promote further development of techniques in nuclear medicine.

A Pilot Study to test the materials was conducted 1995–97 and 1999–2002 and the outcomes demonstrated that student support is vital to their success in achieving a good result. This is the case in any learning environment but more important when the student is studying at a distance and remote from the course management. Ongoing encouragement and help from colleagues in the workplace should provide the student with the motivation required to continue their studies and gain recognition of their achievements. This document provides an overview of the aims of the course and the duties of key personnel who help to make the training a manageable and successful experience.

Occupational function of the graduate

Analysis of the occupational function of a nuclear medicine technologist reveals a number of common features:

- Conducts procedures efficiently and effectively
- Plays a major role in the preparation of radionuclides
- Understands the operation and care of equipment
- Understands the ethical and legal implications in the use of ionising radiation
- Operates equipment skilfully in a given investigation.

Course Objectives

The statement of occupational function of a nuclear medicine technologist assumes a range of skills, knowledge and values. This course of instruction is intended to produce graduates with the following attributes:

- A sound scientific understanding of nuclear medicine imaging.
- An appreciation of the properties of ionising radiation, its hazards and appropriate protective measures that will enable its safe use and application in a clinical setting.
- An ability to produce nuclear medicine images of maximum diagnostic quality, consistent with minimising radiation dose to the patient.
- An understanding of the technologist's role within the professional working environment and with capability to meet the requirements and responsibilities of the profession.
- Humanitarian attitudes and patient handling skills, as well as an appreciation of responsibilities towards the patient.
- A problem solving approach when performing nuclear medicine duties.

ESSENTIAL REQUIREMENTS FOR PARTICIPATION

Programme management

The programme must be managed under the direction of either the National Atomic Energy Authority, the National Society of Nuclear Medicine, Ministry of Education, Ministry of Health, School of Radiography or relevant regulatory authority (or any number of necessary authorities), referred to as the **National Responsible Authority**. In undertaking the implementation of the programme the relevant authority must take responsibility for the following:

- Guarantee that guidelines for participation will be strictly followed
- Ensure that standards for assessment are maintained
- Issue certificates that provide an accurate record of student performance
- Maintain records of student performance
- Report regularly on progress

The National Responsible Authority should appoint a ***National DAT Programme Coordinator*** to oversee the implementation of the project (election of several Programme Coordinators may be justified in large countries where regional coordination is necessary). The National DAT Programme Coordinator should be a person engaged in the practice of nuclear medicine. The formation of a National Steering Committee to oversee the programme with representation from relevant interest groups and stake holders is recommended. A support group should also be identified; this should consist of individuals who agree to assist with student tuition and workshops, provide assistance with student support and should include at least one nuclear medicine physicist and one nuclear medicine specialist to act as local experts.

Basic requirements in departments where trainees are located

The student should be located in an operational nuclear medicine unit with the following minimal equipment and infrastructure:

Resources

1. Gamma Camera and associated computer, dose calibrator, survey meter
2. Designated Hot-Lab area
3. Regular supply of radiopharmaceuticals
4. Access to probe or well counter for completion of some modules
5. Access to a SPECT camera for completion of some advanced modules

For items 4 and 5 rotation of students to sites for experience on equipment not available on-site is acceptable.

Quality of clinical service

In addition the student must practice in a centre which is operated under the supervision of a medical doctor who is trained in nuclear medicine. This is considered an essential component of clinical service.

Entry Requirements for Students

The National Responsible Authorities identified above may use their discretion in applying the minimum requirements.

For example:

Minimum entry requirement:

School to year 10 (O-Level) with a minimum of 5 years NM experience

Or: School to year 12 (A-Level) with a minimum of 2 years NM experience

Or: Radiographer, Medical Lab Tech, Nurse with Certificate /Diploma /Degree

Or: Degree in Science

DAT COURSE - Structure:

The course material has been designed and written in a learning sequence from basic physics and radiation safety, through static imaging to dynamic and gated studies to SPECT imaging. It is recommended that this sequence of learning be applied during the training period.

There are several subjects (units) within each module and the time for study can vary from part-time in-service to full time. The time taken to complete the course material is dependent upon the student's abilities and the available study time. Additional activities such as tutorials, workshops and formal lectures can assist with the understanding.

If you are studying the course material in the recommended learning sequence and conducted as per Distance Assisted Training Programme guidelines then:

- The basic level subjects of the course should be studied in 8 modules covering 15subjects.
- This can be followed by advanced level subjects of 4 modules covering a further 10 subjects.
- On average, each module contains 40 hours of study over a period of 8 weeks.
- The full course requires 5 - 6 hours of study each week over a 2 year period; so, a total of ~600 hrs of study, including time for practical exercises and maintenance of the workbook recording results, important points and protocols.

* Refer page 6 for syllabus overview.

** Details of pre-requisites, objectives and subject content can be reviewed in another document 'DAT Guidelines and Syllabus'.

Flexibility of course implementation

Training courses are conducted in various ways, such as:

- Classroom tuition with " face to face" interaction with the teacher
- Practical based in- house " hands on" training and some tutorials
- Problem based learning when the student is presented with the problem and has to find the answer
- through self-search of literature eg. textbooks, case histories etc.
- Distance learning where the student is living and studying remotely from the tutor and teaching institution but he/she is supplied with training materials designed for learning through self-instruction.

The material for this course of study has been designed to suit various methods of training. Primarily the format is designed for study through self-instruction, offering training to nuclear medicine technologists who are working in areas where there is a little or no opportunity for formal training. All subjects contain practical exercises to reinforce important points and provide opportunities for the student to demonstrate understanding and develop practical skills. The clinical subjects conclude with design of protocols suitable for each student's own department and the requirement to perform the study several times. There are questions throughout the material requiring the student to recognise how and where problems can arise such as image artefacts and how to prevent or correct them. This can help the student develop a problem solving attitude and thus provide a better imaging service.

Where teachers are available but teaching resources are limited then the distance assisted training materials can be used in the classroom and the teacher can add more information, if necessary, and provide "face to face" classroom tutorials to help the student understand. Also where there are already formal training courses in place the teachers may find the distance assisted training materials useful to complement or add to their present teaching resources.

Whichever way the materials are used the important factor is that the student fulfils satisfactory completion, shows understanding and demonstrates adequate practical skills in order to attain a pass mark for each related subject and qualify for the final certificate

Support and Time

Ongoing support and encouragement from colleagues in the workplace should provide motivation for the student to progress and successfully complete the course of study. Work colleagues should be aware of the course objectives, what the student is aiming to achieve and be willing to provide the student with assistance when requested. The supervisor and in particular the physician-in-charge should be committed to helping the student and to be available to answer questions or direct the student to where the answers can be found.

The supervisor and head of department should allocate sufficient time to the student to complete the practical exercises and study the material.

This will include:

- Performing extra views on certain patient studies
- Performing instrumentation quality control procedures
- Discussing clinical, quality control and safety protocols
- Practicing good radiation safety techniques
- Familiarization with computer acquisition and analysis software and other tasks as directed during the course of study.

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Distance Assisted Training Programme
for
Nuclear Medicine Technologists

Syllabus

	Module	Unit	Basic Science	Unit	Clinical
Basic	**1.**	1	Basic Physics		
		2a	Radiation Safety 1		
		3a	Radiopharmacy 1		
		12a	Behavioural Science		
	2.	2b	Radiation Safety 2	12b	Patient Care
		2c	Radiation Biology		
		3b	Radiopharmacy QC		
		4a	Instrumentation 1	6a	Thyroid Uptake
	3	4b	Instrumentation 2	4b	Imaging Techniques
		5a	Computers 1	6b	Thyroid Imaging
				7a	Liver/Spleen
	4.	4c	Instrumentation 3	8	Pulmonary Vent/Perfusion
	5.	5b	Computers 2	9	Skeletal
				13	CSF & Brain (planar)
	6.			10	Renal
				7b	Gastrointestinal – dynamics
	7.			11a	Cardiac – Gated, FP, Hot spot
				11b	Myocardial (planar only)
	8	14a	Radioimmunoassay &		
		14b	Liquid Scintillation Counter		
		14c	Non-Imaging Studies		15 Paediatric Techniques
Advanced	**9.**	16a	Intro. To Human Biology	17a	Infection & Tumour Imaging *WBC labelling & safety*
				17b	Sentinel node detection
	10.	19a	Understanding SPECT	16b	Intro to Sectional Anatomy
		19b	Emission Tomography		
	11.			20	Brain & General SPECT
				21	Myocardial SPECT and planar
	12.	18	Medical Literature Review	22	Parathyroid Imaging
				23	Radionuclide Therapy

The Role of the

National DAT Programme Coordinator

The National DAT Programme Coordinator should represent the National Responsible Authority in conducting the DAT Programme. This person should be someone engaged in the practice of Nuclear Medicine technology who is willing to devote time to the programme. Where appropriate further persons can assist with coordination within national sub-regions, but these persons should liaise closely with the National DAT Programme Coordinator.

In the first instance the National DAT Programme Coordinators should liaise with the National Responsible Authority with regular feedback and assist with student assessment. They will assist in conducting the course such as identifying eligible students, distributing the course material and help solve any local problems.

The National DAT Programme Coordinator should be in a position to:

- Assist in promoting and advertising the course
- Identify participants (eligible students)
- Liaise with:
  National Responsible Authority, local Society of Nuclear Medicine, Atomic Energy, university, hospitals, supervisors and participants

  Through liaison with above institutions:
  - ensure access to photocopier, computer, audiovisual facilities, etc
  - ensure national assistance to cover costs eg. postage, faxes, internal travel
  - coordinate the availability of gamma camera and computer for specific practicals
  - ensure delivery of subject material
  - mark and return assignments
  - advise supervisors and teachers
  - report success / problems to National Responsible Authority
- Coordinate travel/accommodation for students to attend other hospitals and/or workshops
- Assist assessors with visits and in-country travel/accommodation.
- Assist assessors with translation, where necessary, in oral examinations.

Note: There may be occasions where some students can not perform certain studies in their own department but another nuclear medicine department elsewhere in the town/country has the necessary facilities. The National DAT Programme Coordinator should be responsible for arranging student visit(s) to the other department so the student gets the appropriate experience and completes any related exercises.

The Role of the Supervisor

As the student will be working within the nuclear medicine department it is essential that they have support and encouragement from other members of staff. In particular a supervisor should ensure that assistance, when needed, is given to the student. The supervisor will be preferably a senior technologist who should be available to provide advice on a daily basis. However it is essential that the physician in charge of the department fully supports the student's participation and is willing to provide advice on medical issues where needed. Access to a physicist and radiopharmacist on site or at some nearby institution should also be available. The supervisor can help with any issues such as allocating camera time for practical exercises, locating equipment manuals and generally discussing any logistical problems that may arise.

The Supervisor should be in a position to:

- Comment on the feasibility of the practicals within their department eg. available instrumentation.
- Be responsible for feedback to the programme coordinator
- Be aware of the material content and expectations from the students.
- Supervise the students in their department during the training course
- Provide a signature to each section of the student Workbook indicating that the student has completed the exercises and commenting on any particular benefits or difficulties.

Note: The supervisor should be supplied with a set of answers to the Workbook questions.

- Provide ongoing support and encouragement to the students throughout the duration of the course ensuring there is sufficient time to study, perform practicals and offer help where needed.
- Ensure cooperation of the nuclear medicine physician who can discuss clinical protocols and advise on feasibility of nuclear medicine procedures within the department.

Support and Time

Ongoing support and encouragement from colleagues in the workplace should provide motivation for the student to progress and successfully complete the course of study. Work colleagues should be aware of the course objectives, what the student is aiming to achieve and be willing to provide the student with assistance when requested. The supervisor and in particular the physician-in-charge should be committed to helping the student and to be available to answer questions or direct the student to where the answers can be found.
The supervisor and head of department should allocate sufficient time to the student to complete the practical exercises and study the material.

This will include:

- Performing extra views on certain patient studies
- Performing instrumentation quality control procedures
- Discussing clinical, quality control and safety protocols
- Practicing good radiation safety techniques
- Familiarization with computer acquisition and analysis software and other tasks as directed during the course of study.

Example Scenarios:

Throughout the training material the students are required to perform practical exercises which help to reinforce the theory as read in the text. The students are usually advised to ask their Supervisor for help, if necessary. The following list of events provide example situations where the supervisor may be asked to assist the student and provide advice. These scenarios are examples of events reported by supervisors involved during Stage 1 of the Pilot Study.

A. There is a practical exercise when the student is required to demonstrate the effects of differing thickness of lead on the absorption of radiation from a small source of radioactivity, show changes in detected count rate and record results. In some cases the students reported they could not conduct the exercise because varying thickness of lead was not available in their department.

   The exercise is to demonstrate that material of increasing thickness will provide better radiation absorption and offer better protection. In this case the supervisor could suggest other materials such as several pieces of wood, which vary in thickness, or aluminum or brass or even telephone books. These materials will not have the same attenuating properties as lead but the absorbing effect of varying thickness of material will be assist the student to understand the concept.

B. Many nuclear medicine departments are supplied with radionuclides and radiopharmaceutical doses directly from a radiopharmacy laboratory ready for injection and the technologist is not normally involved with the preparation. As part of the technologist's training it is important to understand all aspects of radionuclide imaging including tracer production, preparation and quality control. So it may be necessary for the supervisor to arrange special visits to the radiopharmacy and allocate time for the student to complete practical exercises relating to the course material.

C. Sections on instrumentation include quality assurance exercises on equipment such as the dose calibrator, survey monitor and probe etc. and references to the operational manuals may be required. Sometimes manuals are difficult to locate, particularly with older equipment, so the supervisor may be asked to assist with operation of some instrumentation. Or the supervisor can advise the student where to find the required information or who else to ask for assistance.

D. Feedback from the students has highlighted a common problem – "Not enough time to study". As the student is working as well as undertaking the training course thus the training material has been designed to entail only 5 or 6 hours of study per week. However there are practical exercises to be carried out within the nuclear medicine department in order to complete the course and the supervisor may be required to advise the student on time management and allocate periods of access to the gamma camera/computer and other equipment to perform the exercises.

E. The supervisor will also be asked to help the student identify suitable patients for extra views or particular nuclear medicine studies.

F. In the SPECT subjects the student will be asked to acquire SPECT studies of a phantom but not everyone will have access to a commercially made phantom. However, the student could improvise with a sealed glass/plastic tank or several plastic bottles tied together containing water and radionuclide with objects of known dimensions suspended in the water.

Recommendations for Student Approach to Self Study
for
Distance Assisted Training

Where to begin?

The DAT material content has been designed especially to include the 'Need to Know' and omitting the nice to know, whereby you can get most of the information you need to understand the subject without putting undue strain on your limited study time. The practical activities, problem solving and self assessment are a more motivating way to help you think and learn.

Effective Study

Any form of study may be improved through a series of stages and steps and in turn, this may increase the effectiveness of your study time.
The steps are:

1. **Effective Time Planning**
   - Plan your time correctly and in a manner designed to optimise uninterrupted, wide awake study time.
   - Study one module / chapter at a time.
   - Set reasonable deadlines to complete each section. eg. 6-8 weeks per module
   - Before commencing each section, check which practicals are required and ensure they are completed during the allocated study period.

2. **Reading**
   Read the course material and take in the meaning. Wide margins are provided throughout the written material, use these margins to write your own notes, comments, important points etc. Use a highlight marker pen to focus attention on particular statements regarded as important.

3. **Note Taking**
   Take notes - in preferred language - from the text.

4. **Prepare and plan** carefully for practical exercises and ensure that all necessary materials are readily available.

5. **Mental practice**
   By practising first in your imagination what will later be done in the laboratory, will reduce time spent doing the practical exercise. Generally in a face-to-face teaching practical, the students arrive unprepared and significant time is spent in social conversation and deciding what to do next.

6. **Discuss points with your supervisor/ seek assistance from instructors or tutors.**
   Try to resolve any questions by asking others to help.

Throughout the course of study the student will be expected to:

- **maintain a workbook** recording important points, results of exercises, protocols and **evidence of patient studies** performed.
- **submit regular assignments.** There will be an assignment with each subject which should be completed following the study of the subject and submitted to the programme coordinator for assessment.
- **maintain feedback** to coordinators reporting on any particular problems and achievements encountered or done through the study material.

Group Activities and workshops

Particularly for students who are studying by distance education mode, it is recommended that a mid-course workshop be conducted and / or on-site visits to each student's department be arranged to monitor course effectiveness, student progress and understanding. A workshop can prepare the student for what is expected during the final assessment leading to a more productive and time effective assessment visit. Also a check of the workbooks can assess student progress. National DAT Programme Coordinators are encouraged to arrange these activities.

Structure of Learning Material

Note: The delivery of translated versions of DAT may vary in format and if studying the material in conjunction with another format training course then the delivery of material will be at the discretion of the course lecturer- but it is still recommended that the logical learning sequence be maintained.

To assist with ease of following subjects, a consistent format in presentation contains the following sections in each subject:

Flowchart:
A flowchart for each subject shows how the topic is structured in a learning sequence. It provides the learner with an overview of the chapter titles and highlights practical exercises to be performed.

Outline:
The outline defines the content of the learning unit. It initiates the teaching process and starts the flow of information. In general, it will not supply any specific data, rather it serves to provide an orientation to the topic. The outline may also discuss related learning units or topics.

Introduction:
The introduction will often relate an example or story of a familiar event and equates it to the topic about to be studied. It should provoke forethought and mental preparedness for the subject matter. The introduction will provide reasons for the section to be studied or the practical exercises about to be undertaken.

Objectives:
The objectives will be statements designed to identify as clearly as possible what the student should be able to do on completion of the subject or section in order to demonstrate that something has been learned.

Main body of text:
In this section is the information which allows the student to hopefully understand the topic being presented and upon completion reach the objectives.

Summary:
The summary reiterates the themes of the learning unit and will sometimes help to clarify parts of the text.

Key Points:
The key points reinforce the important points of the subject matter.

Glossary:
At the conclusion of each subject there is a glossary defining the meaning of words and expressions used in the material and where the author offers further explanations.

Questions:
Throughout the teaching material there are series of questions which mainly relate to the topic which has just been taught, Answers to some of these questions are provided at the end of each learning unit. Where indicated, as within most question sections, the answers should be recorded in the workbook.

Activities:
Activities will involve a series of questions, problems and practical exercises which relate to the material provided in the learning unit. Some of the activities presented do not have immediate answers and are provided to stimulate thought in general directions. The questions help the student to establish whether or not he/she has read the learning unit well enough or not.

Reference Text Books:
Any good text book on the practice of nuclear medicine can be used and the subject matter referred to for further reading. This will be relevant particularly in cases where the material has been translated and studied in a language other than English. Most essential reading is included directly in the material.

OVERVIEW OF ASSESSMENT METHODS:

Each country has overall responsibility for conducting the assessment of students but to maintain standards there may be external audit by the IAEA. It is essential that assessment is conducted in a professional manner and coordinated by the DAT Programme Coordinator in conjunction with the National Responsible Authority

As discussed earlier in this document, the training materials may be studied in different ways ie. by itself or as complementing other course material. However it should be noted that, for the students to qualify for the Final Certificate, they must fulfil certain criteria and demonstrate completion, understanding and practical skills for each subject studied.

One of the essential features of any educational course is the measure of success. All students will attempt a variety of assignments, examinations and tests. The purpose of each of these forms of examination is to determine or assess how well they are learning the material which is being taught.

There are number of different types of assessments included in this course:-

- **Regular assignments**: In the format of Multiple Choice Questions.

NOTE: At the end of each module the student should complete and return assignments to their programme coordinator for marking. The return of each assignment will be credited towards subject completion and the marks achieved awarded to subject understanding. Where assignment(s) are not returned 20% will be penalized from completion mark for relevant subject(s).

- **Workbook:** A record of clinical procedures, quality control, radiopharmaceutical preparations etc. which will also act as a protocol reference manual for each student's own department. The workbook must also contain a record of laboratory exercises. Responses must show understanding of the laboratory experience and demonstrate ability in performing assigned tasks. For example: Evidence such as images of five studies, in each clinical category, as performed by the student.

NOTE: A close inspection of the workbook will be made during the assessment visits and questions will be asked on its content.

- **Workshops:**
  It is recommended that workshops be conducted at commencement for preparation, mid-course and end-of-course when assessors visit the students and their supervisors. Preferably groups from different departments and cities should meet at one venue. It brings participants together which will temporarily remove them from their isolation providing stimulation and encouragement. But importantly it provides an opportunity to discuss problems and conduct tutorials where necessary to help explain any difficult concepts. Assessors can check students' workbooks, capabilities, understanding and determine general progress.

- **Final** written examination and practical skills assessment

Criteria for Final Certificate

Students who complete the course satisfactorily and undertake assessment are issued with a Certificate indicating grades achieved for each subject. Completion is indicated, including clinical experience where appropriate. Understanding and practical skills are assessed using a combination of continuing assessment and final examination. The certificate is awarded based on the following criteria:

- Satisfactory **completion :** The course workbook, return of regular assignments and evidence of regular attendance if studying through classroom tutorials, are all indicators of completion. Throughout each subject, the student is directed to their workbook to record details such as important points to remember, results of practical exercises, quality assurance, safety procedures and clinical protocols.
- Evidence of **clinical experience :** For each of the clinical subjects, the student is directed to record details of at least five patient studies in his/her workbook. The records must be signed off by his/her supervisor as having been completed by the student. Evidence of the case studies is reviewed during the workbook assessment.

- Testing **understanding :** This will be monitored through the results of regular assignments for each subject studied. On final assessment, an examination of multiple choice questions, calculations and protocols will also indicate the level of understanding. The student must show his understanding of concepts and important facts.
- Assessment of **practical capabilities:** Suitably qualified assessors observe imaging techniques, proficiency in safety and quality control and adeptness with instrumentation and computer analysis. The assessors will also examine evidence of clinical studies performed and analysed by the student. In the practical assessment the student relates theory to practice, demonstrates ability to apply knowledge, to implement protocol steps and to develop and maintain records.

The objective is to check that the student can complete each of the following tasks:

Part 1A. Basic Sciences:

Hot-Lab Techniques

- Work efficiently in a Hot-Lab adhering to safe practice in radiation safety
- Prepare radiopharmaceutical dose for injection applying quality control procedures and aseptic techniques
- Apply knowledge and demonstrate practical aptitude in dose calibration
- Perform and understand the need for monitoring of the work place and personnel

Quality Control

- Apply knowledge to perform basic gamma camera QC
- Demonstrate knowledge and need for radiopharmaceutical QC
- Apply knowledge to perform Dose Calibrator QC
- Maintains records

Part 1B. Clinical:

Imaging Techniques

- Demonstrate knowledge on appropriate preparation of imaging equipment for a given NM investigation
- Perform appropriate patient preparation and care prior to and during a NM investigation
- Acquire a planar dynamic / static NM study of optimum quality
- Demonstrate knowledge of quality assurance techniques.

Computer Processing

- Apply knowledge of basic operation of nuclear medicine computers
- Apply knowledge of digital acquisition, data analysis and display of results
- Analyse a quantitative dynamic study

Part 2. Advanced:

SPECT Applications

- Perform basic SPECT QC
- Understand basic principles of clinical SPECT acquisition
- Perform SPECT reconstruction
- Display SPECT data correctly
- Identify common SPECT problems
- Apply knowledge in clinical practice

The certificate records the level of achievement with an A/B grade indicating a highly satisfactory / satisfactory result in completion, understanding and practical skills. Where a student fails to gain a satisfactory mark it is indicated with an X. Where assessment has not been possible or there is insufficient evidence of clinical experience in a particular subject this is shown as an O grade.

Recommended minimum requirements

Recommended minimum requirements for students to qualify for external evaluation (e.g. through an independent institution) have been defined as:

- Students should have no more than two incomplete subjects (i.e. <60% complete)
  75% of subjects should be >80% complete (i.e. A level completion).
- It is recognised that students may not have access to patient studies in certain areas, even with rotation to other departments. However students should have no more than 2 gaps in their clinical experience and must have A grade in 6 clinical areas (i.e. have evidence of performing 4-5 clinical studies).
- All grades for understanding and practical skills in basic science, clinical and advanced components must be >=B

Mechanisms for upgrading performance

It is considered useful to encourage students to improve their skills so as to complete the training programme and/or improve their record of achievement. Students could improve their certificate by:

- Completing unfinished subjects
- Gaining additional clinical experience
- Resitting the practical and / or written examination

Upgrade of certificates could be attempted on an annual basis, although students should be allowed a limited number of attempts to sit formal examinations. Note that no provision is made for students to undertake a final examination unless they have completed either the basic modules (1-8) or the complete course.

In Summary:-

To complete the course the student is required to:

- Perform assignments which include practical exercises and provide a record of results.
- Design protocols detailing operational procedures.
- Solve problems showing recognition and ability to resolve artefacts whilst understanding their implications.
- Demonstrate quality assurance procedures.
- Demonstrate understanding of practical aspects such as correct patient positioning, choice of count statistics, collection matrix, dynamic frame rates etc. and image reconstruction.

Distance Assisted Training Programme
for
Nuclear Medicine Technologists

Example only

Certificate of Achievement

This is to certify that

Name:

Year: **Language of Study:**

	Subjects	Completion	Clinical Experience
Basic Science	Physics and Radiation Safety	A	
	Radiation Biology	A	
	Instrumentation	B	
	Computers	B	
	Radiopharmacy	A	
	Behavioural Science	B	
	Patient Care	A	
Clinical	Endocrinology	A	A
	Gastro-intestinal	A	B
	Pulmonary	B	O
	Skeletal	A	A
	Renal	B	A
	Cardiac Blood Pool	B	B
	Myocardial (planar)	N/A	N/A
	Brain Blood Flow & CSF	A	
	Paediatric Techniques	A	
	Radioimmunoassay	B	
	Non-Imaging Studies	B	
Advanced	Medical Literature Review	B	
	Intro. Human Biology	B	
	Sectional Anatomy	A	
	Radionuclide Therapy	B	
	SPECT Physics	B	
	Brain & General SPECT	B	B
	Myocardial SPECT	A	A
	Infection & Tumour	A	B
	Sentinel Node Detection	B	O
	Parathyroid Imaging	A	A

Completion:
A = > 80%
B = 60 – 80%
X = < 60%

Clinical Experience:
A = sufficient evidence
B = some evidence
O = no evidence or no opportunity

Understanding:
A = >80%
B = 60 – 80%
C = 40 – 60%
X = <40%

Practical Skills:
A = >85%
B = 70 – 85%
X = <70%
O = no evidence or no opportunity

N/A (not applicable)

	Understanding	Practical Skills
Basic Science	A	B
Clinical	A	A
Advanced	B	B

Signed: National Responsible Authority _____

GUIDELINES FOR FINAL ASSESSMENT
MECHANISM OF MARKING SYSTEM FOR FINAL CERTIFICATE

Method of marking workbooks

Each section/ subject of the student's workbook is reviewed by an assessor and the percentage of completion assessed. It is expected that more than 80% of each section will be completed.

Note: For each subject where the regular assignment has NOT been returned then 20% will be deducted from the final completion score (exceptions: Behavioural Science and Medical Literature Review).

Clinical Experience

Evidence of completion of five patient studies in each clinical subject (where requested) must be documented in the workbook. It is essential that each case study is signed by the supervisor. The assessor will require a copy of all completed case study forms which should be submitted at time of final workbook assessment.

Understanding

Understanding is measured on:

- Marks from Regular Assignments (33%)
- Marks from the Final Examination: Multiple Choice Questions (33%) and General Questions (33%).

Final Examination

On final assessment the student is required to complete 2 closed book examinations which will test their understanding of the subjects studied during the course. One paper will be approximately 100 Multiple Choice Questions covering basic and advanced subjects. The other paper has General Questions, which are designed to assess understanding of methodology eg. Calculation, sequence of procedures, labelling of diagrams etc. The papers take about 2 hours each and must be conducted under supervision.

Practical Skills

Practical skills are normally assessed after the student has completed the SPECT modules by observing the student's aptitude whilst performing tasks such as maintaining safety procedures, correct patient positioning and competent data analysis. However if the student is not progressing to the advanced level then their basic practical skills can be assessed only. The following pages describe the assessment criteria in each of the areas for practical assessment. Please read following carefully in preparation for practical skills assessment.

GUIDELINES FOR STUDENTS IN PRACTICAL ASSESSMENT
Objective Structured Clinical Evaluation

A COPY OF THIS DOCUMENT SHOULD BE GIVEN TO ALL STUDENTS PRIOR TO FINAL ASSESSMNENT

Each student will be assessed individually as he prepares for performs patient studies.

Note: General confidence and organizational skills will also contribute to assessment results.

Dose Preparation

Specified Outcome	Assessment criteria
Hot-Lab Skills	Adherence to safe procedures when handling radioactive material (apply time, distance, shielding) Appropriate disposal of waste products
Demonstrate radiation safety and aseptic techniques when handling radiopharmaceuticals.	
Dose Calculation	Ability to calculate and measure appropriate dose for administration
Apply knowledge and demonstrate practical aptitude in dose calibration.	
General Safety	Appropriate personal monitoring devices worn at all times. Ability to use monitoring devices
Perform and understand the need for monitoring of work place and personnel	
Quality Control	
Radiopharmacy Quality Control (QC)	QC tests performed on radiopharmaceuticals.
Demonstrate and apply knowledge of radiopharmaceutical preparations utilising safety procedures and aseptic techniques. Demonstrate knowledge and need for quality control.	
Dose Calibrator QC	Checks background and reference source readings. Records maintained.
Perform basic dose calibration QC	
Gamma Camera QC	Uniformity QC test correctly performed. Records maintained.
Apply knowledge to perform basic gamma camera QC	

Patient and Gamma Camera Imaging procedures

Specified Outcome	Assessment criteria
Patient preparation	Communicates with patient, makes appropriate checks and demonstrates patient cares.
Demonstrates ability to communicate with the patient and make appropriate preparations for optimum results.	
Dose administration	Dose administrated by appropriate person. Student should make appropriate checks.
Applies care to ensure patient dose is appropriate	
Instrumentation 'set-up'	Appropriate instrumentation and auxiliary equipment is utilized.
Study Acquisition	Understanding of anatomical relationships and organ physiology to perform NM investigation is demonstrated. Gamma Camera Acquisition parameters correctly selected Acquisition data correctly recorded.
Applies knowledge and understanding of anatomy, physiology and pathology of the stated systems in the imaging context. Applies knowledge of study acquisition	
Quality Assurance	Understands factors effecting quality. Records accurate details.
Confirms that results are of satisfactory quality	

"Computer Processing"

Specified Outcome	Assessment criteria
Computer :	
Processing: **A. Display** Applies knowledge of study display on computer **B. Dynamic study analysis** Applies knowledge of analysing a dynamic study on computer **C. Quality Assurance**	Data appropriately displayed and labelled Data appropriately analysed Recognises sources of error Confirms results are meaningful

Advanced Skills "SPECT Applications"

Specified outcome	Assessment task
SPECT QC Able to perform basic SPECT QC	Measure planar uniformity: NEMA Measure COR
Acquisition: Understand basic principles of clinical SPECT acquisition	Correctly position patient Choose appropriate parameters Check acquired study
Reconstruction: Able to perform SPECT reconstruction, choose appropriate filter and display results	Choose appropriate filter Perform reconstruction Perform study reorientation Arrange final display
Quality Assurance: Can identify common SPECT problems	Confirm results Recognise artifacts Understand reason for loss of resolution