Guidelines

for

Competency Based Training Programme

in

DNB- Nuclear Medicine

NATIONAL BOARD OF EXAMINATIONS

Medical Enclave, Ansari Nagar, New Delhi-110029, INDIA
Email: mail@natboard.edu.in Phone: 011 45593000

CONTENTS

INTRODUCTION

- Nuclear medicine is a medical specialty involving the application of radioactive substances in the diagnosis and treatment of disease. In nuclear medicine procedures, radionuclides are combined with other elements to form chemical compounds, or else combined with existing pharmaceutical compounds, to form radiopharmaceuticals.
- These radiopharmaceuticals, once administered to the patient, can localize to specific organs or cellular receptors. This property of radiopharmaceuticals allows nuclear medicine the ability to image the extent of a disease process in the body, based on the cellular function and physiology, rather than relying on physical changes in the tissue anatomy.
- In some diseases, nuclear medicine studies can identify medical problems at an earlier stage than other diagnostic tests. Nuclear medicine, in a sense, is "radiology done inside out", or "endo-radiology", because it records radiation emitting from within the body rather than radiation that is generated by external sources like X-rays.
- Nuclear Medicine & Radiation Therapy is a medical specialty involving the application of radioactive substances in the diagnosis and treatment of disease.
- Nuclear medicine is the bridge between a particular clinical problem and a relevant test using radionuclides.
- It began as a minor technical tool used in a few branches of medicine, notably endocrinology and nephrology.
- However, throughout the world it has now become established as a clinical discipline in its own right, with specific training programmes, special skills and a particular approach to patient management.
- Although the practicing nuclear medicine physician must necessarily learn a great deal of basic science and technology, a sound medical training and a clinical approach to the subject remains of fundamental importance.
- Nuclear medicine is the medical specialty that utilizes the nuclear properties of radioactive nuclides to make diagnostic evaluations of the anatomical and/or physiological conditions of the body and to provide therapy with unsealed radioactive sources.

PROGRAMME GOAL

Graduates from this training program will be equipped to function effectively within the current and emerging professional, medical and societal contexts. It is expected that graduates of the program will have developed the clinical skills and have acquired the theoretical knowledge for competent nuclear medicine practice. It is expected that a new nuclear medicine specialist will have:

- High level skills in the technical processes and routine procedures undertaken in the specialty
- An approach to clinical judgement and to the practice of nuclear medicine that focuses on the clinical setting and on the pathophysiological processes involved in each case
- The ability to apply a well-developed and appropriately structured knowledge base in internal and nuclear medicine and correlative imaging to the primary areas of professional practice of the specialty
- Research skills to support ongoing evidence-based practice in the specialty
- High level communication skills, especially in the explanation and reporting of procedures and studies employed in the specialty. Graduates of the program will be able to employ these skills with referring doctors, other health professionals, and with patients and members of their families
- Well-developed educational skills to support a teaching role in areas related to the specialty, especially with medical students, junior staff, allied health professionals, and members of the public
- Quality assurance skills to enable the implementation and ongoing evaluation of nuclear medicine practice to a high technical and professional standard
- Organisational skills to support independent practice in nuclear medicine, as well as contributions to and leadership of hospital teams
- A high standard of ethical and professional behaviour.

PROGRAMME OBJECTIVES

- At the completion of the Nuclear Medicine Advanced Training Program, trainees should be competent to provide, at consultant level, unsupervised comprehensive medical care in nuclear medicine.

- Attaining competency in all aspects of this curriculum is expected to take two to three years of training. It is expected that all teaching, learning and assessment associated with the Nuclear Medicine Curriculum will be undertaken within the context of the specialist's everyday clinical practice and will accommodate discipline-specific contexts and practices as required.

- As such it will need to be implemented within the reality of current workplace and workforce issues and the needs of health service provision.

ELIGIBILITY CRITERIA FOR ADMISSIONS TO THE PROGRAMME

(A) DNB Nuclear Medicine Course:

1. Any medical graduate with ***MBBS*** qualification , who has qualified the ***Entrance Examination*** conducted by NBE and fulfill the eligibility criteria for admission to DNB ***Broad Specialty*** courses at various NBE accredited Medical Colleges/ institutions/Hospitals in India is eligible to participate in the Centralized counseling for allocation of DNB Nuclear Medicine seats purely on merit cum choice basis.

2. Admission to 3 years post MBBS DNB Nuclear Medicine course is only through ***Entrance Examination*** conducted by NBE and Centralized Merit Based Counseling conducted by National Board of Examination as per prescribed guidelines.

(B) DNB (Post diploma) Nuclear Medicine Course:

1. Any medical graduate with MBBS qualification who has successfully completed **DNM** (and fulfill the eligibility criteria for admission to DNB (Post Diploma) Broad Specialty courses at various NBE accredited Medical Colleges/ institutions/Hospitals in India is eligible to participate in the Centralized counseling for allocation of **DNB (Post Diploma) Nuclear Medicine** seats purely on merit cum choice basis.

2. Admission to 2 years **post diploma DNB Nuclear Medicine** course is only through PDCET Centralized Merit Based Counseling conducted by National Board of Examination as per prescribed guidelines.

Duration of Course :

For Primary candidates : 3 years
For Secondary Candidates : 2 years

Every candidate admitted to the training programme shall pursue a regular course of study (on whole time basis) in the concerned recognized institution under the guidance of recognized post graduate teacher for assigned period of the course.

TEACHING AND TRAINING ACTIVITIES

The fundamental components of the teaching programme should include:

1. Case presentations & discussion- once a week
2. Seminar – Once a week
3. Journal club- Once a week
4. Grand round presentation (by rotation departments and subspecialties)- once a week
5. Faculty lecture teaching- once a month
6. Clinical Audit-Once a Month
7. A poster and have one oral presentation at least once during their training period in a recognized conference.

The rounds should include bedside sessions, file rounds & documentation of case history and examination, progress notes, round discussions, investigations and management plan) interesting and difficult case unit discussions.

The training program would focus on knowledge, skills and attitudes (behavior), all essential components of education. It is being divided into theoretical, clinical and practical in all aspects of the delivery of the rehabilitative care, including methodology of research and teaching.

Theoretical: The theoretical knowledge would be imparted to the candidates through discussions, journal clubs, symposia and seminars. The students are exposed to recent advances through discussions in journal clubs. These are considered necessary in view of an inadequate exposure to the subject in the undergraduate curriculum.

Symposia: Trainees would be required to present a minimum of 20 topics based on the curriculum in a period of three years to the combined class of teachers and students. A free discussion would be encouraged in these symposia. The topics of the symposia would be given to the trainees with the dates for presentation.

Clinical: The trainee would be attached to a faculty member to be able to pick up methods of history taking, examination, prescription writing and management in rehabilitation practice.

Bedside: The trainee would work up cases, learn management of cases by discussion with faculty of the department.

Journal Clubs: This would be a weekly academic exercise. A list of suggested Journals is given towards the end of this document. The candidate would summarize and discuss the scientific article critically. A faculty member will suggest the article and moderate the discussion, with participation by other faculty members and resident doctors. The contributions made by the article in furtherance of the scientific knowledge and limitations, if any, will be highlighted.

Research: The student would carry out the research project and write a thesis/ dissertation in accordance with NBE guidelines. He/ she would also be given exposure to partake in the research projects going on in the departments to learn their planning, methodology and execution so as to learn various aspects of research.

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SCIENTIFIC BASIS OF NUCLEAR MEDICINE

1. **Radio Biology, Radiation safety Quality Assurance in Nuclear Medicine**

1.1.1 Knowledge

- Outline the basic principles of radioactive decay, nuclear reactions and production of radionuclides, detection and measurement of ionising radiation
- Discuss the effects of ionising radiation on humans
- Describe the legislative control of radiation in India and the world
- Describe the principles and procedures of radiation protection as applied to nuclear medicine, including the as low as reasonably achievable (ALARA) principle
- Describe the principles of operation of SPECT, PET, CT and hybrid SPECT/CT and PET/CT cameras, including:
- performance characteristics, and differences between cameras
- quality control
- equipment specification and selection
- computer acquisition
- image processing and display

1.1.2 Skills

- Outline the basic principles of radioactive decay, nuclear reactions and production of radionuclides, detection and measurement of ionising radiation
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- Describe the principles and procedures of radiation protection as applied to nuclear medicine, including the as low as reasonably achievable (ALARA) principle
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- performance characteristics, and differences between cameras
- quality control
- equipment specification and selection
- computer acquisition
- image processing and display
- Explain and apply principles of radiation safety to:
- adult patients, including pregnant or breastfeeding patients
- paediatric patients
- practice staff
- Advise referring doctors, medical students, nuclear medicine technologists, and junior medical staff about the principles of:
- radiation safety, including legislative requirements
- operation of SPECT, PET, CT, and hybrid cameras
- principles of radiopharmaceutical chemistry

- recent developments and trends in nuclear medicine instrumentation and diagnostic and therapeutic radiopharmaceuticals.

1.2. Biostatistics

1.2.1 **Knowledge**

- The trainee shall have the basic skills to be able to understand the following parameters used in assessing research and apply them critically to any relevant scientific paper:
- Ethical basis of research
- Prospective or retrospective
- Sample size
- Appropriate methodology
- How the data is assessed
- Appropriate use of statistics and their meaning
- The use of the terms phase 1, phase 2 and phase 3 trials
- Understanding the requirements and limitations of randomized controlled trials
- How results may affect practice or determine the need for further research
- The importance of looking at levels of evidence such as the Cochrane method

1.2.2 **Skills**

- The trainee will be able to critically assess research in the field of nuclear medicine and radiology
- Be able to understand both strengths and weaknesses of research

- Understand the particular limitations which occur in research in imaging

2. DIAGNOSTIC NUCLEAR MEDICINE

2.1 Cardiovascular Nuclear Medicine

2.1.1 Knowledge

- Basic Anatomy of the heart
- Understand the pathophysiology of coronary artery disease, exercise testing, heart failure
- Discuss the appropriateness of using various PET and SPECT techniques to determine myocardial perfusion and viability

2.1.2 Skills

- Supervise and interpret resting and exercise ECGs
- Supervise and interpret stress testing using pharmacological agents
- Assess coronary artery disease using SPECT radiopharmaceuticals
- Assess ventricular function using radionuclide ventriculography
- Assess congenital heart disease using radiolabelled shunt studies
- Perform I-123 MIBG adrenergic cardiac imaging studies
- Discuss the role of complementary imaging techniques for cardiac disease
- Discuss the role of CTCA in the management of coronary artery disease
- Assess myocardial perfusion using SPECT and PET techniques
- Assess myocardial viability using SPECT and PET techniques

- Cardiac transplant evaluation

2.2 Endocrine Nuclear Medicine

2.2.1 Knowledge

- Identify anatomy and common variants of the thyroid and parathyroid glands and explain their anatomical relations in the neck
- Identify the surface anatomy of the thyroid and parathyroid glands
- Understand the pathophysiology of parathyroid disease and its clinical importance.
- Discuss the physiology of the thyroid gland with reference to control by TRH/TSH and thyroid hormone synthesis and storage
- Describe thyroid function tests and the results in hyper- and hypothyroidism
- Describe iodine handling by the thyroid
- Pathophysiology of different causes of hyperthyroidism
- Different treatment option for patients with hyperthyroidism
- Appropriate selection of patients with hyperthyroidism for I-131
- Pathophysiology of thyroid cancer
- Understand both the dosimetric and empirial methods method used in treating hyperthyroidism and thyroid cancer with I-131
- Identify anatomy of the adrenal glands
- Discuss hormone production and secretion by the adrenal glands
- Understand the pathophysiology of medullary and cortical adrenal tumours. Know the probability of bilateral disease or malignant spread

2.2.2 Skills

- Perform and interpret radioisotope scans for the thyroid gland using both technetium and radioactive iodine

- Assess thyrotoxicosis and thyroid nodules
- Reading pre-therapy radioisotope studies to determine if treatment is appropriate with I-131
- Performing and interpreting parathyroid scintigraphy including both planar and SPECT imaging
- Interpret adrenal cortical imaging
- Perform and interpret I-131 MIBG imaging for detection and staging of pheochromocytomas
- Perform and interpret newer agents for detection of Pheochromocytoma like FDG PET imaging, Somatostatin recenptor PET among others
- Be able to assess and treat a patient of hyperthyroidism with radioactive iodine
- Discuss the appropriate assessment, risk stratification and management of thyroid cancer
- Discuss the role of complementary imaging techniques for endocrine disease

2.3 Gastrointestinal Nuclear Medicine

2.3.1 Knowledge

- Describe the pathophysiology of GI motility disorders
- Describe the pathology of primary and secondary hepatic tumours
- Describe the pathophysiology of acute and chronic cholecystitis, biliary dyskinesia, sphincter of Oddi dysfunction, cystic duct syndrome, and post cholecystectomy syndrome
- Describe the pathology relating to GI haemorrhage
- Describe the pathology of IBD
- Describe the pathology of intra-abdominal sepsis

2.3.2 Skills

- To assess the diseases of GI motility
- Assess gallbladder and biliary function using hepatobiliary scans
- Assess GI haemorrhage
- Assess inflammatory bowel disease (IBD) and intra-abdominal sepsis
- Assess abnormal splenic function using Tc-99m labelled tracers
- Assess hepatic artery catheters and peritoneal-venous shunts using Tc-99m labelled tracers
- Describe the use of salivary and lacrimal gland imaging
- Assess GI disease using complementary GI imaging techniques

2.4 Genitourinary Nuclear Medicine

2.4.1 Knowledge

Describe the pathophysiology of:

- renovascular hypertension (RVH)
- types of urinary tract obstruction and the effects of diuretics on these mechanisms
- acute pyelonephritis and renal scarring
- transplant rejection
- vesicoureteric reflux
- renal failure
- acute tubular necrosis (ATN)
- acute epididymitis and testicular torsion

2.3.2 Skill

- Perform and interpret a renal dynamic study with emphasis on obstruction, renovasular hypertension and renal malformation
- Perform and interpret renal cortical imaging
- Perform and interpret DRCG scans for VUR
- Perform and interpret imaging for renal infection and inflammation
- Assess a renal transplant patient
- Assess renal failure
- Discuss the role of complementary imaging techniques for genitourinary disease

2.4 Infection and Inflammation Nuclear Medicine

2.4.1 Knowledge

- Describe the fundamentals of humoral inflammation and cellular inflammation
- Describe the general characteristics of neutrophils, lymphocytes, monocytes, and macrophages, and their role in the body's resistance to infection
- Skills
- Assess infection and inflammation using nuclear medicine techniques
- Recognise the emerging role of PET in the assessment of inflammation or infection

2.5 In Vitro Nuclear Medicine Techniques

- Assess patients using C-14 urea breath tests to evaluate Helicobacter pylori infection
- Assess patients using C-13/14 breath tests to evaluate intestinal absorption
- Assess patients using Cr-51 EDTA, Tc-99m DTPA to evaluate renal function
- Discuss the role and use of Cr-51 RBCs to evaluate GI bleeding
- Discuss radioiodine uptake or the assessment of thyroid function
- Perform and interpret GFR calculation using Plasma Clearance method of Tc-99mDTPA and Cr51 EDTA

2.6 Musculoskeletal Nuclear Medicine

2.6.1 Knowledge

- Describe the pathogenesis and pathological features of osteoporosis, Paget's disease, osteomalacia, hyperparathyroidism, and renal osteodystrophy
- Describe the clinicopathological features of regional migratory osteoporosis
- Describe the effects on bone metabolism of the various physical and pharmacological treatments that are employed in the treatment and prevention of osteoporosis.
- Describe the pathogenesis and pathological features of acute and chronic osteomyelitis (including vertebral osteomyelitis), septic arthritis and discitis.

- Describe the natural history of periprosthetic bone changes in cemented and non-cemented prosthetic joint replacements Arthritis and Related Conditions:
- List the causes of inflammatory arthritis and describe the basic clinicopathological features of these conditions, including reference to the distribution of joint involvement
- Describe the basic clinicopathological features of osteoarthritis and degenerative disease of the spine
- Describe the aetiology of osteonecrosis, including radiation osteonecrosis, and bone infarction
- Describe the clinicopathological features of complex regional pain syndrome/reflex sympathetic dystrophy (CRPS/RSD)

2.6.2 Skills

- Describe techniques of bone scintigraphy and PET imaging
- Assess musculoskeletal trauma
- Assess metabolic bone disease
- Assess skeletal infection
- Assess prosthetic joint replacements
- Assess patients following spinal surgery
- Assess arthritis and related conditions
- Discuss the role of complementary musculoskeletal imaging modalities

2.7 Neurological Nuclear Medicine

2.7.1 Knowledge

- Discuss the anatomy of the brain and spinal cord with particular emphasis on cross-sectional anatomy
- Identify the surface markings of the cerebral lobes
- Identify the intracerebral structures of the brain in transverse, sagittal, and coronal planes
- Identify the cerebral arteries, the territories that they perfuse, and their relations to other cerebral structures
- Identify the cerebral veins and sinuses and their relations to other cerebral structures
- Identify the cerebral ventricles and their relations to other cerebral structures, including the spinal cord
- Discuss the physiology of the brain in normal and abnormal states, with particular attention to regional cerebral perfusion
- Explain the fundamentals of cerebral perfusion and autoregulation
- Describe the relationship between cerebral perfusion and cerebral metabolism in health and disease
- Explain the concepts of cerebral blood volume and luxury perfusion • explain the effect of seizures on cerebral blood flow
- Describe the pathophysiology of atherosclerosis, cerebral ischemia, cerebral infarction, cerebral atrophy, intracranial haemorrhage, intracranial aneurysms, intracranial vascular malformations, cerebral tumours, cerebral vasculitis, drug induced cerebral injury, cerebral HIV/AIDS, and encephalitis
- Describe the pathophysiology and classification of seizures
- Describe the pathophysiology and classification of dementia
- Describe the physiology of CSF production and flow

- Describe the pathophysiology of normal pressure hydrocephalus, obstructed hydrocephalus, non-obstructed hydrocephalus, and CSF leaks
- Describe the pathophysiology of brain death

2.7.2 Skills

- Perform and interpret cerebral perfusion studies using SPECT and PET
- Assess disorders of CSF flow and suspected CSF leaks using scintigraphic techniques
- Perform and interpret FDG PET /SPECT studies for classification of Dementias
- Perform and interpret ictal and interictal studies for localizing the epileptogenic focus
- Identify emerging brain SPECT and PET techniques
- Assess impaired neurological function using complementary imaging technique

2.8 Evaluation of Osteoporosis

- Describe techniques used to evaluate osteoporosis
- Assess quality assurance procedures in bone mineral density (BMD) estimation
- Interpret and report lumbar spine BMD scans
- interpret and report proximal femur BMD scans
- Assess BMD in appendicular skeleton
- Assess total body bone mineral and body composition

- Outline absolute fracture risk

Oncological Nuclear Medicine

2.8.1Knowledge

- Understand the pathophysiology of cancer
- Be able to take an appropriate history from the patient (or their parents) and examine the patient as required
- Understand how F-18 FDG may be used to diagnose lung cancer in a patient with a single pulmonary nodule or stage a patient which CT suggests is operable
- Understand the role of FDG imaging in a range of cancers
- Know the health economic arguments concerning the use of PET-CT in diagnosing and staging cancer
- Know the causes of a false negative or false positive result
- Be able to identify other unsuspected pathology on the PET or CT study

2.8.2 Skills

- Be able to run a glucose clamp in a diabetic patient if required
- Be able to decide if a study is positive for cancer and also be able to determine if a patient with known cancer is operable
- Recognise issues related to mis-registration of fusion images and be able to determine how the effect of this may be reduced
- Be able to recognise the causes of false positive uptake of F-18 FDG

and if possible how to differentiate this uptake from cancer

- Know when additional images/tests may be required
- Keep up to date with the latest research findings and recommendations on the use of F-18 FDG PET in cancer
- Be able to confidently present the results in an MDT
- Assess patients with lung cancer
- Assess patients with GI malignancies
- Assess patients with breast cancer
- Assess patients with head and neck malignancies
- Assess patients with melanoma
- Assess patients with neuroendocrine tumours
- Assess patients with lymphoma and other haematological malignancies
- Assess patients with gynaecological malignancies
- Assess patients with sarcoma
- Assess primary bone tumours
- Assess skeletal metastatic disease
- Assess patients with brain malignancy
- Assess patients using lymphoscintigraphy
- Explain the use of radiological imaging to assist in the interpretation of oncological nuclear medicine studies

2.9 Newer Advances in PET

- Understand PET can be used in a variety of different diseases using a variety of PET pharmaceuticals to look at a different types of disease including:
- F-18 skeletal disease
- F-18 FLT cancer cell turnover
- F-18 choline Renal cell cancer/ Prostate cancer
- F-18 DOPA pancreatic neuroendocrine tumours
- Parkinson's syndrome
- F-18 FMISO Hypoxia
- C-11 or F-18 beta amyloid for Alzheimer's disease
- C-11 /F18 agents for Brain primary tumours
- Ga-68/ Somatostatins Neuroendocrine tumours
- Understand the mechanism of uptake of each agent and what may lead to a false negative or false positive study
- Understand the imaging protocol for each agent and for each indication
- Be aware of the legal framework in place when using novel tracers

2.10 Pulmonary Nuclear Medicine

2.10.1 Knowledge

- Identify the lobes and fissures of the lungs and their anatomical relations in the thorax
- Identify the bronchopulmonary segments of both lung and their projections in both two dimensional and three dimensional imaging
- Describe the physiologic features of ventilatory function, measurement of ventilatory function, and patterns of abnormal function

- Describe the physiologic features of the pulmonary circulation, measurement of pulmonary circulation, and patterns of abnormal function
- Describe the physiologic features of gas exchange, measurement of gas exchange, and mechanisms of abnormal function • describe the relationship between pulmonary blood flow and pulmonary ventilation under normal conditions and in PE
- Describe the metabolic functions of the lung and its effects on lung physiology

2.10.2 Skills

- Describe the assessment, management, and outcomes of pulmonary embolism (PE) and deep venous thrombosis (DVT)
- Assess PE using ventilation and perfusion imaging
- Discuss the role of ancillary tests and complementary imaging techniques for PE
- Assess patients by quantitation of lung ventilation and perfusion
- Assess inflammatory lung disease

2.11 PAEDIATRIC NUCLEAR MEDICINE

Diagnostic

- Describe the basic principles of paediatric nuclear medicine
- Assess musculoskeletal disorders
- Assess genitourinary disorders
- Assess GI disorders
- Assess infection and inflammation

- Assess thyroid disease
- Assess pulmonary disease
- Assess malignancy
- Assess neurological disease
- Assess congenital cardiac disease

2.12 Sentinel Node imaging

2.12.1 Knowledge

- Understand the pathophysiology of malignant disease know how it spreads and in which cancers sentinel node localization is both possible and useful
- Identify and discuss the different techniques available for sentinel node localization
- Know when and if SPET/CT may be of use
- Understand how the images analyzed and are displayed for reading, including the use of a “shadow gram”

2.12.2 Skills

- Inject radiotracers for sentinel node localization
- Use intra-operative hand held probe for sentinel lymph node localization

3. Radionuclide Therapy

Basic Knowledge

- Describe the mechanisms of radiation-induced cell damage

- Describe tissue characteristics that modify the response to radiation-induced injury
- Describe the general characteristics of the relationship between cell cycle and radiation-induced injury
- Describe the effects of toxic doses of radiation on normal organs

3.1. **Treatment of Hyperthyroidism with I-131**

3.1.1 **Knowledge**

- Pathophysiology of different causes of hyperthyroidism
- Different treatment option for patients with hyperthyroidism
- Appropriate selection of patients with hyperthyroidism for I-131
- Understand appropriate follow-up required for patients having been treated with I-131
- Reading pre-therapy radioisotope studies to determine if treatment is appropriate with I-131
- Understand both the dosimetric and empirical methods method used in treating hyperthyroidism with I-131
- Understand the legislation concerning the safe delivery of I-131 including radiation protection for self, other staff and the patient's care givers

3.1.2 Skills

- Be able to take relevant history and perform relevant clinical examination within thyroid clinic
- Recognise those complications that would be a contra-indication to treatment with I-131
- Be able to explain the treatment and obtain consent for treatment with

special reference to female patient's concerns about fertility and contraception

- Be able to advise on management of thyroid eye disease
- Give advice on termination and re-commencement of anti-thyroid medication
- Arrange appropriate follow-up and further management of the patient

3.2 I -131 therapy for treatment of patients with thyroid cancer

3.2.1 Knowledge

- Pathophysiology of thyroid cancer
- Different treatment option for patients with thyroid cancer
- Appropriate selection of patients with hyperthyroidism for I-131. Understand the need for ablation of thyroid remnant
- Understand the long term prognosis of the disease in patients treated or not with I-131
- Understand appropriate follow-up required for patients having been treated with I-131 for thyroid cancer
- Reading pre-therapy radioisotope studies to determine if treatment is appropriate with I-131 including I-123 and F-18 FDG PET imaging
- Understand both the dosimetric and empirial methods method used in treating thyroid cancer with I-131
- Understand the advantages and disadvantages and methodology of use of withdrawal of thyroid hormone supplementation and/or TSH stimulation in preparation for therapy
- Understand the role of thyroglobulin in the long term follow-up of patients with thyroid cancer

- Understand the legislation concerning the safe delivery of I-131 including radiation protection for self, other staff and the patient's care givers
- Understand special requirements for treatment of patients under the age of 18
- Work with the thyroid cancer MDT to determine best management of the patient
- Recognise those complications that would be a contra-indication to treatment with I-131

3.2.2 Skills

- Be able to prepare the patient for therapy with I-131 including use of low-iodine diets and side effects of thyroid hormone supplement withdrawal
- Be able to explain the treatment and obtain consent for treatment with special reference to female patient's concerns about fertility and contraception
- Give advice on termination and re-commencement of thyroxine replacement therapy
- Arrange appropriate follow-up and further management of the patient
- Be responsive to the concerns of the patient and their carers concerning treatment in particular reference to concerns the patient may have about cancer
- Communicate essential information in an appropriate and timely way
- Be aware of issues concerning fertility and contraception in different ethnic cultures and how that impacts on patient care

3.3 Radionuclide synovectomy

3.3.1 **Knowledge**

Pathophysiology of different causes of inflammatory joint disease Different treatment options with inflammatory joint disease Appropriate selection of patients for treatment with radionuclides

- Understand appropriate follow-up required for patients having been treated with radiation synovectomy including awareness of complications including infection and radionecrosis
- Know the European Association of Nuclear Medicine guidelines on appropriate radio-isotope and activity to be given depending on joint and the number of joints that can be treated at any given time
- Understand the need for immobilisation of the joint for 24 hours after treatment
- Understand the legislation concerning the safe delivery of Y-90, Re-186 and Eu-169 including radiation protection for self, other staff and the patient's care giver

3.3.2 **Skill**

- Be able to take relevant history and perform relevant clinical examination of patient with joint disease
- Be able to explain procedure to patient and obtain consent
- Be able to ensure correct activity of radiopharmaceutical has been drawn up
- Be able to have skills to inject joints using a sterile technique or use other clinicians such as radiologists and rheumatologist to obtain access to the joint
- Be able to withdraw an appropriate amount of fluid from the joint and

give corticosteroids if indicated

- Able to give radioisotopes without contamination of patient, self or colleagues
- Give advice post therapy complication and suggest appropriate actions
- Ensure patient's joint is appropriately immobilised for at least 24 hours

Arrange appropriate follow-up and further management of the patient

3.4 Radiolabelled antibodies in haematological malignancy

3.4.1 **Knowledge**

- Pathophysiology of lymphoma, leukaemia and myeloma and when to use of radiolabelled antibodies in treatment of these diseases
- Be aware of probable success of treatment compared to alternative therapies. In addition possible side effects compared to alternate treatments and long term prognosis including risk of myleofibrosis and acute leukaemia
- Appropriate selection of patients for patients with hyperthyroidism with these agents
- Be aware of the use of immunohistochemistry in identifying patients appropriate for treatment
- Know in which clinical situations pre-scanning with a tracer dose is needed for dosimetric assessment or to determine suitability for treatment
- Be aware of the indications for use of Y-90 tiuxetan ibritumomab and other available agents
- Be aware of the dosing regimes for use of Y-90 tiuxetan ibritumomab (or other agents)

- Be aware of the need for conditioning with un-radiolabelled antibodies such as Rituximab and the required timings for these treatments
- Be aware if the treatment will be performed in isolation or in combination with other anti-cancer drugs or bone marrow transplant
- Understand the legislation concerning the safe delivery of Y-90 and I-131 products including radiation protection for self, other staff and the patient's careers
- Be able to discuss appropriate use of Y-90 tiuxetan ibritumumab or alternate agents with haematological colleagues including within an MDT
- Recognise those complications that would be a contra-indication to treatment with these agents

3.4.2 Skills

- Be happy to administer these drugs via a central line catheter using an aseptic technique
- Be able to explain the treatment and obtain consent for treatment with special reference to female patient's concerns about fertility and contraception
- Communicate to the patient a realistic view of outcomes in these treatments
- Understand the experimental nature of some of these treatments
- Be prepared to treat acute anaphylaxis or other less acute immune reactions
- Arrange appropriate follow-up and further management of the patient

3.5 Radionuclide treatment for bone metastases

3.5.1 **Knowledge**

- Pathophysiology of bone metastases and the methods used to treat bone pain
- Understand the relevance and useful of diagnostic imaging with Tc-99m MDP/HDP in selecting patients for therapy
- Be aware of probable success of treatment compared to alternative therapies. In addition possible side effects compared to alternate treatments and long term prognosis including risk of bone marrow suppression
- Appropriate selection of patients for treatment via site specific MDT
- Understand appropriate preparation of patient for treatment of painful bone metastases including whether or not it will be given in combination with chemotherapy drugs and/or bisphosphonates
- Be aware of recommendations for activities to be given for both the beta emitters Sr-89, Sm-153 EDTMP, Re-186/Re-188 HEDP and the alpha emitter Ra-233
- Understand the appropriate dosing regimes including standard dose and weight related dosing including minimum time intervals for repeat treatments
- Understand the legislation concerning the safe delivery of these products and the different requirements for radiation protection for self, other staff and the patient's carers with each agents

3.5.2 Skills

- Be able to discuss appropriate use of agents used to treat painful bone metastases with colleagues including within an MDT

- Recognise those complications that would be a contra-indication to treatment with each agent with particular reference to possible hematological toxicity
- Understand that some contra-indications such as risk of long bone and vertebral fracture may be treated and then the patient presented for therapy
- Be able to explain the treatment and obtain consent for treatment with special reference to female patient's concerns about fertility and contraception (where relevant)
- Communicate to the patient a realist view of outcomes in this palliative treatment
- Be able to explain the possibility of a flare reaction, the best methods to treat and expected duration
- Explain how success in treatment is determined including the use of pain diaries the expected duration of treatment and the time when a repeat treatment may be given
- Arrange appropriate follow-up and further management of the patient

3.6.1 I -131 mIBG therapy

3.6.1 Knowledge

- Pathophysiology of those tumours including neuroblastoma, phaeochromocytoma, paraganglioma and neuroendocrine tumours in which I-131 mIBG may be useful
- Understand the relevance and useful of diagnostic imaging with I-123/I-131 mIBG in selecting patients for therapy
- Be aware of probable success of treatment compared to alternative therapies. In addition possible side effects compared to alternate

treatments and long term prognosis including risk of bone marrow suppression and effects on the thyroid

- Appropriate selection of patients for treatment with I-131 mIBG
- Understand appropriate follow-up required for patients having been treated with I-131 mIBG with appropriate referring clinician
- In particular be aware of the dosimetric and empirical approach to treatment
- Understand the legislation concerning the safe delivery of I-131 mIBG including radiation protection for self, other staff and the patient's carers

3.6.2 Skills

- Be able to discuss appropriate use of I-131 mIBG with oncological colleagues including within an MDT
- Know how patients should be prepared for therapy for example the stopping or reduction of drugs which interfere with uptake and the need to give appropriate cover with potassium iodide
- Recognise those complications that would be a contra-indication to treatment with I-131 mIBG for example when and where cardiovascular monitoring is required
- Be able to deal with any resultant cardiovascular side effect
- Be able to explain the treatment and obtain consent for treatment with special reference to female patient's concerns about fertility and contraception
- Communicate to the patient a realist view of outcomes in this palliative treatment
- Arrange appropriate follow-up and further management of the patient

- Be able to deal with the special concerns in treating children including the fears and hopes of the patient's family/guardians
- Be responsive to the concerns of the patient (and parent/guardian) and their carers concerning treatment and an understanding of expectations and long term effects of treatment
- When treating children be able to communicate in a manner appropriate for the child's age and development

3.7 Radiolabelled Peptide/Radioligand therapy

- Pathophysiology of those tumours including phaeochromocytoma, paraganglioma, prostate cancer, neuroendocrine tumours among others in which radiolabelled peptides/ligands may be useful
- Understand the relevance and useful of diagnostic imaging with In-111 pentatreotide/Ga-68 DOTATATE/NOC/TOC/PSMA and other agent PET in selecting patients for therapy and how this helps patient selection
- Understand the relationship between the diagnostic and therapeutic peptides used
- Be aware of the legislation required to perform radiolabelled somatostatin therapy
- Be aware of the different peptides available and the characteristics of Y-90 and Lu-177 and how selections are made on the combination used for therapy
- Be aware of probable success of treatment compared to alternative therapies. In addition possible side effects compared to alternate treatments and long term prognosis including risk of bone marrow suppression and renal failure and the need for co-administration of anionic amino acids

- Understand appropriate follow-up required for patients having been treated with radiolabelled somatostatins with the appropriate referring clinician
- In particular be aware of published dosing regimes
- Understand the legislation concerning the safe delivery of both Y-90 and Lu-177 labelled agents including radiation protection for self, other staff and the patient's carers
- Be aware of newer advances in radiopeptide therapy including the use of alpha emitters
- Skills
- Be able to discuss appropriate use of radiolabelled somatostatins with oncological colleagues including within an MDT
- Know how patients should be prepared for therapy for example the stopping or reduction of short acting or long acting somatostatins and starting amino acid infusions at least 1 hour prior to therapy and providing anti-emetics
- Be able to explain the treatment and obtain consent for treatment with special reference to female patient's concerns about fertility and contraception. Also explain the dosing regime (normally 3-4 cycles every 6-12 weeks)
- Communicate to the patient a realist view of outcomes in this palliative treatment
- Arrange appropriate follow-up and further management of the patient
- Be able to deal with the special concerns in treating children including the fears and hopes of the patient's family/guardians

3.7 Intra-arterial therapy of liver primary cancer/metastatic disease

3.7.1 Knowledge

- Pathophysiology of primary and secondary cancers within the liver
- Understand the relevance and use of diagnostic imaging with CT/MRI and PET in selecting patients for therapy
- Be aware of probable success of treatment compared to alternative therapies. In addition possible side effects compared to alternate treatments and long term prognosis including risk of bone marrow suppression and effects on the thyroid
- Appropriate selection of patients for treatment including size and site of tumor(s) and the presence or absence of portal vein thrombosis
- Understand appropriate follow-up required for patients having been treated with these agents with appropriate referring clinician
- Be aware of guidelines for treatment with Y-90 particulates
- In particular be aware of the dosimetric and empirical approach to treatment
- Understand that TARE with Y-90 labeled or other agents particulates a pre-dosing intra- arterial Tc-99m MAA scan should be performed to determine both the possibility of shunting to the lungs (must be less than 20%) and effect on the administered activity
- Understand the legislation concerning the safe delivery of Y-90 labeled products including radiation protection for self, other staff and the patient's care givers

3.7.2 Skills

- Be able to discuss appropriate use of Y-90 particulates and other agents with colleagues including within an MDT
- Know how patients should be prepared for therapy for example the

requirements for intra-arterial cannulation including clotting screen and platelet count

- Be able to give product safely within the sterile facilities of X-ray special suite
- Be able to explain the treatment and obtain consent for treatment with special reference to female patient's concerns about fertility and contraception
- Communicate to the patient a realistic view of outcomes in this palliative treatment
- Be able to deal with the special concerns in treating children including the fears and hopes of the patient's family/guardians

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Topics to be included in all subjects:

- **Biostatistics, Research Methodology and Clinical Epidemiology**
- **Ethics**
- **Medico legal aspects relevant to the discipline**
- **Health Policy issues as may be applicable to the discipline**

THESIS PROTOCOL & THESIS

The candidates are required to submit a thesis at the end of three years of training as per the rules and regulations of NBE.

Guidelines for Submission of Thesis Protocol & Thesis by candidates

Research shall form an integral part of the education programme of all candidates registered for DNB degrees of NBE. The Basic aim of requiring the candidates to write a thesi protocol & thesis/dissertation is to familiarize him/her with research methodology. The members of the faculty guiding the thesis/dissertation work for the candidate shall ensure that the subject matter selected for the thesis/dissertation is **feasible, economical** and **original**.

Guidelines for Thesis Protocol

The protocol for a research proposal (including thesis) is a study plan, designed to describe the background, research question, aim and objectives, and detailed methodology of the study. In other words, the protocol is the 'operating manual' to refer to while conducting a particular study.

The candidate should refer to the NBE Guidelines for preparation and submission of Thesis Protocol before the writing phase commences. The minimum writing requirements are that the language should be clear, concise, precise and consistent without excessive adjectives or adverbs and long sentences. There should not be any redundancy in the presentation.

The development or preparation of the Thesis Protocol by the candidate will help her/him in understanding the ongoing activities in the proposed area of research. Further it helps in creating practical exposure to research and hence it bridges the connectivity between clinical practice and biomedical research. Such research exposure will be helpful in improving problem solving capacity, getting updated with ongoing research and implementing these findings in clinical practice.

Research Ethics: Ethical conduct during the conduct and publication of research is an essential requirement for all candidates and guides, with the primary responsibility of ensuring such conduct being on the thesis guide. Issues like Plagiarism, not maintaining the confidentiality of data, or any other distortion of the research process will be viewed seriously. The readers may refer to standard documents for the purpose.

The NBE reserves the right to check the submitted protocol for plagiarism, and will reject those having substantial duplication with published literature.

PROTOCOL REQUIREMENTS

1. All of the following will have to be entered in the online template. The thesis protocol should be restricted to the following word limits.

- Title : 120 characters (with spacing) page
- Synopsis [structured] : 250-300
- Introduction : 300-500
- Review of literature : 800-1000
- Aim and Objectives : Up to 200
- Material and Methods : 1200-1600
- 10-25 References [ICMJE style]

2. It is mandatory to have ethics committee approval before initiation of the research work. The researcher should submit an appropriate application to the ethics committee in the prescribed format of the ethics committee concerned.

Guidelines for Thesis

1. The proposed study must be approved by the institutional ethics committee and the protocol of thesis should have been approved by NBE.

2. The thesis should be restricted to the size of 80 pages (maximum). This includes the text, figures, references, annexures, and certificates etc. It should be printed on both sides of the paper; and every page has to be numbered. Do not leave any page blank. To achieve this, following points may be kept in view:

    a. The thesis should be typed in 1.5 space using Times New Roman/Arial/ Garamond size 12 font, 1" margins should be left on all four sides. Major sections viz., Introduction, Review of Literature, Aim & Objectives, Material and Methods, Results, Discussion, References, and Appendices should start from a new page. Study proforma (Case record form), informed consent form, and patient information sheet may be printed in single space.
    b. Only contemporary and relevant literature may be reviewed. Restrict the introduction to 2 pages, Review of literature to 10-12 pages, and Discussion to 8-10 pages.
    c. The techniques may not be described in detail unless any modification/innovations of the standard techniques are used and reference(s) may be given.
    d. Illustrative material may be restricted. It should be printed on paper only. There is no need to paste photographs separately.

3. Since most of the difficulties faced by the residents relate to the work in clinical subject or clinically-oriented laboratory subjects, the following steps are suggested:
    a. The number of cases should be such that adequate material, judged from the hospital attendance/records, will be available and the candidate will be able to collect case material within the period of data collection, i.e., around 6-12 months so that he/she is in a position to complete the work within the stipulated time.
    b. The aim and objectives of the study should be well defined.
    c. As far as possible, only clinical/laboratory data of investigations of patients or such other material easily accessible in the existing facilities should be used for the study.
    d. Technical assistance, wherever necessary, may be provided by the department concerned. The resident of one specialty taking up some problem related to some other specialty should have some basic knowledge about the subject and he/she should be able to perform the investigations independently, wherever some specialized laboratory investigations are required a co-guide may be co-opted from the concerned investigative department, the quantum of laboratory work to be carried out by the candidate should be decided by the guide & co-guide by mutual consultation.

4. The clinical residents are not ordinarily expected to undertake experimental work or clinical work involving new techniques, not hitherto perfected OR the use of chemicals or radioisotopes not readily available. They should; however, be free to enlarge the scope of their studies or undertake experimental work on their own initiative but all such studies should be feasible within the existing facilities.

5. The DNB residents should be able to freely use the surgical pathology/autopsy data if it is restricted to diagnosis only, if however, detailed historic data are required the resident will have to study the cases himself with the help of the guide/co-guide. The same will apply in case of clinical data.

6. Statistical methods used for analysis should be described specifically for each objective, and name of the statistical program used mentioned.

General Layout of a DNB Thesis:

- **Title-** A good title should be brief, clear, and focus on the central theme of the topic; it should avoid abbreviations. The Title should effectively summarize the proposed research and should contain the PICO elements.
- **Introduction-** It should be focused on the research question and should be directly relevant to the objectives of your study.

- **Review of Literature -** The Review should include a description of the most relevant and recent studies published on the subject.

- Aim and Objectives - The 'Aim' refers to what would be broadly achieved by this study or how this study would address a bigger question / issue. The 'Objectives' of the research stem from the research question formulated and should at least include participants, intervention, evaluation, design.

- **Material and Methods-** This section should include the following 10 elements: Study setting (area), Study duration; Study design (descriptive, case-control, cohort, diagnostic accuracy, experimental (randomized/non-randomized)); Study sample (inclusion/exclusion criteria, method of selection), Intervention, if any, Data collection, Outcome measures (primary and secondary), Sample size, Data management and Statistical analysis, and Ethical issues (Ethical clearance, Informed consent, trial registration).

- **Results-** Results should be organized in readily identifiable sections having correct analysis of data and presented in appropriate charts, tables, graphs and diagram etc.

- **Discussion–**It should start by summarizing the results for primary and secondary objectives in text form (without giving data). This should be followed by a comparison of your results on the outcome variables (both primary and secondary) with those of earlier research studies.

- **Summary and Conclusion-** This should be a précis of the findings of the thesis, arranged in four paragraphs: (a) background and objectives; (b) methods; (c) results; and (d) conclusions. The conclusions should strictly pertain to the findings of the thesis and not outside its domain.

- **References-** Relevant References should be cited in the text of the protocol (in superscripts).

- **Appendices -**The tools used for data collection such as questionnaire, interview schedules, observation checklists, informed consent form (ICF), and participant information sheet (PIS) should be attached as appendices. Do not attach the master chart.

Thesis Protocol Submission to NBE

1. DNB candidates are required to submit their thesis protocol within 90 days of their joining DNB training.

2. Enclosures to be submitted along with protocol submission form:
    a) Form for Thesis Protocol Submission properly filled.
    b) Thesis Protocol duly signed.
    c) Approval letter of institutional Ethical committee. *(Mandatory, non receivable of any one is liable for rejection)*

Thesis Submission to NBE

1. As per NBE norms, writing a thesis is essential for all DNB candidates towards partial fulfillment of eligibility for award of DNB degree.
2. DNB candidates are required to submit the thesis before the cut-off date which shall be 30th June of the same year for candidates appearing for their scheduled December final theory examination. Similarly, candidates who are appearing in their scheduled June DNB final examination shall be required to submit their thesis by 31st December of preceding year.
3. Candidates who fail to submit their thesis by the prescribed cutoff date shall NOT be allowed to appear in DNB final examination.
4. Fee to be submitted for assessment (In INR): 3500/-
5. Fee can be deposited ONLY through pay-in-slip/challan at any of the Indian bank branch across India. The challan can be downloaded from NBE website www.natboard.edu.in
6. Thesis should be bound and the front cover page should be printed in the standard format. A bound thesis should be accompanied with:
    a. A Synopsis of thesis.
    b. Form for submission of thesis, duly completed
    c. NBE copy of challan (in original) towards payment of fee as may be applicable.
    d. Soft copy of thesis in a CD duly labeled.
    e. Copy of letter of registration with NBE.

7. A declaration of thesis work being bonafide in nature and done by the candidate himself/herself at the institute of DNB training need to be submitted bound with thesis. It must be signed by the candidate himself/herself, the thesis guide and head of the institution, failing which thesis shall not be considered.

The detailed guidelines and forms for submission of Thesis Protocol & Thesis are available at www.natboard.edu.in.thesis.php.

LOG BOOK

A candidate shall maintain a log book of operations (assisted / performed) during the training period, certified by the concerned post graduate teacher / Head of the department / senior consultant.

This log book shall be made available to the board of examiners for their perusal at the time of the final examination.

The log book should show evidence that the before mentioned subjects were covered (with dates and the name of teacher(s) The candidate will maintain the record of all academic activities undertaken by him/her in log book .

1. Personal profile of the candidate
2. Educational qualification/Professional data
3. Record of case histories
4. Procedures learnt
5. Record of case Demonstration/Presentations
6. Every candidate, at the time of practical examination, will be required to produce performance record (log book) containing details of the work done by him/her during the entire period of training as per requirements of the log book. It should be duly certified by the supervisor as work done by the candidate and countersigned by the administrative Head of the Institution.
7. In the absence of production of log book, the result will not be declared.

Leave Rules

1. DNB Trainees are entitled to leave during the course of DNB training as per the Leave Rules prescribed by NBE.
2. A DNB candidate can avail a maximum of 20 days of leave in a year excluding regular duty off/ Gazetted holidays as per hospital/institute calendar/policy.
3. MATERNITYLEAVE:
    a. Afemale candidate is permitted a maternity leave of 90 days once during the entire duration of DNB course.
    b. The expected date of delivery (EDD) should fall within the duration of maternity leave.
    c. Extension of maternity leave is permissible only for genuine medical reasons and after prior approval of NBE. The supporting medical documents have to be certified by the Head of the Institute/hospital where the candidate is undergoing DNB training. NBE reserves its rights to take a final decision in such matters.
    d. The training of the candidate shall be extended accordingly in case of any extension of maternity leave being granted to the candidate.
    e. Candidate shall be paid stipend during the period of maternity leave. No stipend shall be paid for the period of extension of leave.
4. Male DNB candidates are entitled for paternity leave of maximum of one week during the entire period of DNB training.
5. No kind of study leave is permissible to DNB candidates. However, candidates may be allowed an academic leave as under across the entire duration of training program to attend the conferences/CMEs/Academic programs/Examination purposes.

DNB COURSE	NO. OF ACADEMIC LEAVE
DNB 3 years Course (Broad & Super Specialty)	14 Days
DNB 2 years Course (Post Diploma)	10 Days
DNB Direct 6 years Course	28 days

6. Under normal circumstances leave of one year should not be carried forward to the next year. However, in exceptional cases such as prolonged illness the leave across the DNB training program may be clubbed together with prior approval of NBE.
7. Any other leave which is beyond the above stated leave is not permissible and shall lead to extension/cancellation of DNB course.
8. Any extension of DNB training for more than 2 months beyond the scheduled completion date of training is permissible only under extra-ordinary circumstances with prior approval of NBE. Such extension is neither automatic nor shall be granted as a matter of routine. NBE shall consider such requests on merit provided the seat is not carried over and compromise with training of existing trainees in the Department.
9. Unauthorized absence from DNB training for more than 7 days may lead to cancellation of registration and discontinuation of the DNB training and rejoining shall not be permitted.
10. Medical Leave
    a. Leave on medical grounds is permissible only for genuine medical reasons and NBE should be informed by the concerned institute/hospital about the same immediately after the candidate proceeds on leave on medical grounds.
    b. The supporting medical documents have to be certified by the Head of the Institute/hospital where the candidate is undergoing DNB training and have to be sent to NBE.
    c. The medical treatment should be taken from the institute/ hospital where the candidate is undergoing DNB training. Any deviation from this shall be supported with valid grounds and documentation.
    d. In case of medical treatment being sought from some other institute/hospital, the medical documents have to be certified by the Head of the institute/hospital where the candidate is undergoing DNB training.

e. NBE reserves its rights to verify the authenticity of the documents furnished by the candidate and the institute/hospital regarding Medical illness of the candidate and to take a final decision in such matters.

11.

a. Total leave period which can be availed by DNB candidates is 120+28 = 148 days for 6 years course, 60+14=74 days for 3 years course and 40+10 = 50 days for 2 years course. This includes all kinds of eligible leave including academic leave. Maternity / Paternity leave can be availed separately by eligible candidates. Any kind of leave including medical leave exceeding the aforementioned limit shall lead to extension of DNB training. It is clarified that prior approval of NBE is necessary for availing any such leave.

b. The eligibility for DNB Final Examination shall be determined strictly in accordance with the criteria prescribed in the respective information bulletin.

EXAMINATION

FORMATIVE ASSESSMENT

Formative assessment includes various formal and informal assessment procedures by which evaluation of student's learning, comprehension, and academic progress is done by the teachers/ faculty to improve student attainment. Formative assessment test (FAT) is called as "Formative "as it informs the in process teaching and learning modifications. FAT is an integral part of the effective teaching .The goal of the FAT is to collect information which can be used to improve the student learning process.

Formative assessment is essentially positive in intent, directed towards promoting learning; it is therefore part of teaching. Validity and usefulness are paramount in formative assessment and should take precedence over concerns for reliability. The assessment scheme consists of Three Parts which has to be essentially completed by the candidates.

The scheme includes:-

Part I:- Conduction of theory examination
Part-II :- Feedback session on the theory performance
Part-III :- Work place based clinical assessment

Scheme of Formative assessment

PART – I	**CONDUCT OF THEORY EXAMINATION**	Candidate has to appear for Theory Exam and it will be held for One day.
PART – II	**FEEDBACK SESSION ON THE THEORY PERFORMANCE**	Candidate has to appear for his/her Theory Exam Assessment Workshop.
PART – III	**WORK PLACE BASED CLINICAL ASSESSMENT**	After Theory Examination, Candidate has to appear for Clinical Assessment.

The performance of the resident during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student

1. Personal attributes:

- **Behavior and Emotional Stability:** Dependable, disciplined, dedicated, stable in emergency situations, shows positive approach.
- **Motivation and Initiative:** Takes on responsibility, innovative, enterprising, does not shirk duties or leave any work pending.

- **Honesty and Integrity:** Truthful, admits mistakes, does not cook up information, has ethical conduct, exhibits good moral values, loyal to the institution.
- **Interpersonal Skills and Leadership Quality:** Has compassionate attitude towards patients and attendants, gets on well with colleagues and paramedical staff, is respectful to seniors, has good communication skills.

2. Clinical Work:

- **Availability:** Punctual, available continuously on duty, responds promptly on calls and takes proper permission for leave.
- **Diligence:** Dedicated, hardworking, does not shirk duties, leaves no work pending, does not sit idle, competent in clinical case work up and management.
- **Academic ability:** Intelligent, shows sound knowledge and skills, participates adequately in academic activities, and performs well in oral presentation and departmental tests.
- **Clinical Performance:** Proficient in clinical presentations and case discussion during rounds and OPD work up. Preparing Documents of the case history/examination and progress notes in the file (daily notes, round discussion, investigations and management) Skill of performing bed side procedures and handling emergencies.

3. Academic Activity: Performance during presentation at Journal club/ Seminar/ Case discussion/Stat meeting and other academic sessions. Proficiency in skills as mentioned in job responsibilities.

FINAL EXAMINATION

The summative assessment of competence will be done in the form of DNB Final Examination leading to the award of the degree of Diplomate of National Board in Nuclear Medicine. The DNB final is a two-stage examination comprising the theory and practical part. An eligible candidate who has qualified the theory exam is permitted to appear in the practical examination.

Theory Examination

1. The theory examination comprises of ***Three/ Four*** papers, maximum marks 100 each.
2. There are 10 short notes of 10 marks each, in each of the papers. The number of short notes and their respective marks weightage may vary in some subjects/some papers.
3. Maximum time permitted is 3 hours.
4. Candidate must score at least 50% in the aggregate of ***Three/ Four*** papers to qualify the theory examination.

5. Candidates who have qualified the theory examination are permitted to take up the practical examination.
6. The paper wise distribution of the Theory Examination shall be as follows:

Paper I: Basic sciences applied to the specialty including Medicine and surgery
Basic physics and Nuclear Physics
Research Methodology

Paper II: Physics of Nuclear Medicine instrumentation & Nuclear Medicine Techniques
Radiochemistry & Radio pharmacy

Paper III: Clinical Nuclear Medicine

Paper IV: Radio Biology, Radiation safety Quality Assurance in Nuclear Medicine
Recent advances and Investigations

a) Practical Examination:

1. Maximum Marks: 300.
2. Comprises of Clinical Examination and Viva.
3. Candidate must obtain a minimum of 50% marks in the Clinical Examination (including Viva) to qualify for the Practical Examination.
4. There are a maximum of three attempts that can be availed by a candidate for Practical Examination.
5. First attempt is the practical examination following immediately after the declaration of theory results.
6. Second and Third attempt in practical examination shall be permitted out of the next three sessions of practical examinations placed alongwith the next three successive theory examination sessions; after payment of full examination fees as may be prescribed by NBE.
7. Absentation from Practical Examination is counted as an attempt.
8. Appearance in first practical examination is compulsory;
9. Requests for Change in center of examination are not entertained, as the same is not permissible.
10. Candidates are required not to canvass with NBE for above.

Declaration of DNB Final Results

1. DNB final is a qualifying examination.
2. Results of DNB final examinations (theory & practical) are declared as PASS/FAIL.
3. DNB degree is awarded to a DNB trainee in the convocation of NBE.

RECOMMENDED TEXT BOOKS AND JOURNALS

a. Textbooks

1. Conventional Nuclear medicine in Pediatrics (A Clinical based atlas) by Garganese, Maria Carmen, D'Errico, Giovanni Francesco Livio (Eds.)
2. Principles and Practice of Nuclear Medicine by Paul J.Early
3. Essentials of Nuclear Medicine Imaging by Fred A.Mettler
4. Reconstruction Tomography in Diagnostic Radiology and nuclear medicine by Michel M.Ter-Pogossian.
5. Internal Radiation Dosimentry:1994 Health physics summer school by Otto G.Raabe
6. Mird Primer for Absorbed Dose Calculations by Robert Loevinger
7. Mird: Radionuclide Data and Decay schemes by Keith F. Eckerman
8. Mird Cellular S.Values: self-absorbed dose per unit cumulated activity for selected radionuclides and monoenergetic electron and alpha particle emitters incorporated into different cell compartments by S.Murty Goddu
9. PET: Molecular Imaging and its biological applications by Michael E.Phelps
10. Positron Emission Tomography: Basic Sciences by Dale L.Bailey
11. Single-Photon Emission Computed Tomography by Barbara Y.Croft
12. Monte Carlo Calculations in Nuclear Medicine: Applications in Diagnostic Imaging by Ljungberg Ljungberg
13. Therapeutic Applications of Monte Carlo Calculations in Nuclear Medicine by Habib Zaidi
14. Dictionary And Handbook of Nuclear Medicine And Clinical Imaging by Mario P. Iturralde
15. Handbook of Nuclear medicine by Mark T.Madsen
16. Nuclear Medicine Board Review: Questions and answers for self assessment by Richard Goldfarb
17. Practical Nuclear Medicine by Edwin L.Palmer
18. Handbook of Nuclear Medicine :handbooks in radiology series by Frederick L.Datz
19. Nuclear Medicine:Case Review series by Harvey A.Ziessman
20. Nuclear Medicine :The Requisites by Harvey A.Ziessman
21. Nuclear medicine Imaging: A Teaching File by M.Reza Habibian
22. Nuclear Radiology (Fifth series) test and syllabus by Barry A.Siegel
23. Clinical Atlas of Pet: With Imaging Correlation by Michael S.Kipper
24. Atlas of Clinical Nuclear medicine by Ignac Fogelman
25. Nuclear Medicine: A Teaching file by Frederick L.Datz
26. Radiopharmaceuticals for Therapy 2016 by FF.Knapp, Ashutosh Dash
27. Nuclear Medicine in Clinical Diagnosis and Treatment by Peter Josef ELL, Sam Gambhir

28. PET Imaging of Thoracic Disease, an issue of PET Clinics by Drew A.Torigian, Abass Alavi
29. Radiation Safety in Nuclear Medicine by Max H.Lombardi
30. Diagnostic Nuclear Medicine: A Physics Perspective by Dr.David Hamilton
31. Frontiers in Nuclear Medicine (Nuclear Medicine in Clinical Oncology :Current status and future aspects by Cuno Winkler, Contributions by J.Adelstein
32. Clinical Nuclear Medicine: Edited by Hans-Jurgen Biersack, Leonard M.Freeman
33. Essentials of Nuclear Medicine by M.V Merrick
34. Basic sciences of Nuclear Medicine by Magdy M.Khalil
35. Radiation physics for nuclear medicine by Marie Claire Cantone, Christroph Hoeschen
36. Progress in Radiopharmacy by P.H.Cox, edited by Steven J.Mather, C.B Sampson, C.R Lazarus
37. Nuclear Medicine in Tropical and Infectious Diseases by Francisco Jose H.N Braga
38. Radioguided Surgery edited by Giuliano Mariani, Armando E.Giuliano, H.William Strauss.
39. Exercises in Clinical Nuclear medicine by Gary Cook, Jane Dutton
40. Herbal Radiomodulators : Applications in medicine, Homeland defence and space edited by R.Arora
41. Radiotherapy and Brachytherapy by Yves Lemoigne, Alessandra Caner
42. Safety and Efficacy of Radiopharmaceuticals edited by Knud Kristensen, Elisabeth Norbygaard
43. Radioprotectors: Chemical, Biological, and clinical Perspective by Edward A.Bump, Kamal Malaker
44. Diagnostic Nuclear Medicine : A Physics Perspective by David I.Hamilton, P.J Riley

List of Major Journals on Nuclear Medicine

- Radiotherapy and Oncology.
- Medical Physics ('The International Journal of Medical Physics')
- Physics in medicine and biology.
- Medical Dosimetry.
- Radiation Oncology.
- The British Journal of Radiology.
- Medical & Biological Engineering & Computing.
- Biological Engineering, IFMBE.
- Applied Radiation and Isotopes
- Nuclear Instruments and Methods in Physics Research
- The Journal of Applied Clinical Medical Physics
- Physica Medica
- Australian Physics & Engineering Science in Medicine
- Acta Oncologica
- International Journal of Radiation Research (IJRR)
- Journal of Medical Physics
- Technology in Cancer Research and Treatment
- Reports of Practical Oncology and Radiotherapy
- BMC Medical Physics
- Journal of Medical Imaging and Radiation Oncology
- Journal of Medical Imaging and Radiation Sciences
- Medical Image Analysis
- Radiological Physics and Technology
- Radiation Physics and Chemistry
- The Journal for Radiation Physics, Radiation Chemistry and Radiation Processing
- Polish Journal of Medical Physics and Engineering
- Practical Radiation Oncology
- Journal of Radiation Research
- Japanese Journal of Radiology
- Clinical Oncology
- Radiation Research

- Nuclear Instruments and Methods in Physics Research
- Radiation Measurements
- The Journal of Radiotherapy in Practice
- Journal of Cancer
- European Journal of Cancer
- South Asian Journal of Cancer
- Blood Cancer Journal
- Journal of Radiology & Radiation Therapy
- International Journal of Radiation Oncology
- ASRT Journals and Magazines
- Radiation Oncology and Cancer
- Journal of Medical Radiation Sciences
- Frontiers in Oncology
- American Society for Radiation Oncology (ASTRO)
- Frontiers of Radiation Therapy and Oncology
- Journal of Cancer Research and Therapeutics
- Global Journal of Advanced Radiation Research
- International Journal of Cancer Therapy and Oncology

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