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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – MAY/JUNE 2013

### SUBJECT: PAPER I: RADIO PHARMACY – II

Monday, May 27, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

✍ **Answer all questions.**

1. Write in short about the followings:

1A. Laminar Air Flow Cabinet

1B. Hospital Radiopharmacy Vs Centralised Radiopharmacy

1C. TLC Scanner

1D. F-18 FDG synthesis

(5×4= 20 marks)

2A. Enlist the physical characteristics of positron emitting radionuclides produced by generators suitable for PET imaging. (no details).

2B. Justify why safe Handling of radiopharmaceutical is considered as a Good Radiopharmacy Practices. (no details) .

2C. Write about the active transport mechanism of radio pharmaceutical localization in different organs with examples.

2D. What is lyophilisation? Why is it required? Describe in brief about lyophiliser. (no details).

(5×4 = 20 marks)

3A. Define Cold kit with reference to radiopharmaceuticals. Explain the importance of the constituents present in the cold kits for 99mTc Radiopharmaceuticals. How to check the stability of cold kits?

3B. Write about any two methods of iodination technique with the radioiodination principle.

3C. Describe about the Automatic Synthesis modules in radiochemistry lab. Enumerate the commercially available Automatic Synthesis modules for F-18 and C-11 labelled radiotracers.

3D. With Suitable examples explain the Desired and Undesired drug interactions with radiopharmaceuticals.

(10×4 = 40 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. N.M.T. DEGREE EXAMINATION – MAY/JUNE 2013

### SUBJECT: PAPER II: NUCLEAR MEDICINE INSTRUMENTATION – II

Wednesday, May 29, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

**Answer all Questions.**

1. What are collimators? What are the different types of collimators used in Nuclear Medicine imaging?

(2+8 = 10 marks)

2. Compare and contrast the different detectors used in PET imaging. Which according to you is the best? Justify.

(8+2 = 10 marks)

**3. Answer any TWO from the following:**

3A. Parameters to be considered in SPECT acquisition.

3B. Iterative Reconstruction Technique

3C. Photon Attenuation

(5+5 = 10 marks)

4. What are the factors affecting the detection efficiency?

(10 marks)

5. Briefly describe as how the spatial resolution of the gamma camera could be studied.

(10 marks)

6. Explain about the different events and data acquisition in PET with suitable diagrams.

(10 marks)

7. Write about the filters and their use in Nuclear Medicine Imaging.

(10 marks)

8. What is ring artifact? What are the causes for it? What tests should be performed to rule out the causes?

(2+3+5 = 10 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – MAY/JUNE 2013

### SUBJECT: PAPER III: NON IMAGING NUCLEAR MEDICINE TECHNIQUES

Friday, May 31, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

**Answer all the Questions.**

1. A male patient is suffering from Megaloblastic anaemia has been referred to the department of Nuclear Medicine to rule out Vitamin $B_{12}$ deficiency due to Intrinsic factor deficiency. Write in details:
   a) Physical properties of the radionuclides used for Schilling test.
   b) Patient preparation, procedure protocol for Schilling Test I and II.

(10 marks)

2. Explain on the reagents of RIA.

(10 marks)

3. Describe the importance of tracer in RIA. Which one is the best tracer and state the reason(s).

(10 marks)

4. Write short notes on:

4A. Automated Radiometric Detection System. (Labelled Diagram)

4B. Clinical application of radiometric system.

(10 marks)

5A. Define and explain propagation of errors.

5B. Explain the Rose Model equation in imaging.

(5+5 = 10 marks)

6A. What is the specific requirements consideration in radiotracer kinetics?

6B. What is the importance of Compartment analysis in tracer kinetics?

(5+5 = 10 marks)

7. In brief explain the working principle of an intraoperative gamma probe.

(10 marks)

8. Which non imaging instrument gives you function of thyroid gland? What is Isoresponse curve? How to do a thyroid uptake study?

(10 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – MAY/JUNE 2013

### SUBJECT: PAPER VI: RADIATION BIOLOGY AND RADIATION PROTECTION

Friday, June 07, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

- **Answer ALL questions.**
- **Students are instructed to answer Section – A and Section – B on the separate answer paper.**

## SECTION – A: RADIATION BIOLOGY (30 MARKS)

**1. Write short notes on the following:**

1A. Effects of human fetal radiation.

1B. Law of Bergonie and Tribondeau.

1C. Concept of lethal dose.

1D. Deterministic effects Vs Stochastic effects.

1E. Photoelectric Effect.

(6×5 = 30 marks)

## SECTION – B: RADIATION PROTECTION ( 50 MARKS)

**2. Answer the following:**

2A. Write briefly about stochastic and deterministic effects.

2B. A patient is given 3.5 MBq of I-131 orally. Assume the uptake to the thyroid is 30%, the average energy of the beta particles is 0.1915 MeV, the biological half-life is 80 days and the mass of the thyroid is 20 grams. Calculate the total dose to the thyroid.

(5×2 = 10 marks)

**3. Answer the following:**

3A. Discuss in detail about the emergency situations that may arise in Nuclear medicine department. How do they occur? How can you prevent them?

3B. Explain the MIRD method to calculate how much radiation dose is delivered to a target organ from radioactivity contained in source organ/s in the body.

(20×2 = 40 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – MAY/JUNE 2013

### SUBJECT: PAPER IV: IMAGING NUCLEAR MEDICINE TECHNIQUES

Monday, June 03, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

**Answer all questions.**

1. A female patient has been referred to the dept. of Nuclear Medicine for a denatured RBC scan of the spleen. Write about
   a) Patient preparation.
   b) Radiopharmaceutical preparation.
   c) Acquisition protocol.
   d) Interpretation of the study.

(20 marks)

2. A patient has been referred for the assessment of Reno vascular hypertension. Discuss the patient preparation and the imaging protocol with 99mTc-DTPA. Describe the renogram pattern with a tubular agent for a high probability Reno vascular hypertension.

(20 marks)

3. A 30 yrs old female dancer patient with a history of stress fracture left tibia has been referred to the department for a 99mTc MDP bone scan. Write about

3A. Pharmaceutical preparation
3B. Acquisition protocol
3C. Patient preparation.
3D. Interpretation of the study.

(5+8+4+3 = 20 marks)

**4. Short notes:**

4A. Ideal pharmaceuticals for infection imaging.
4B. Gall bladder ejection fraction.
4C. Bone marrow imaging.
4D. Lung perfusion Scintigraphy

(5×4 = 20 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – MAY/JUNE 2013

### SUBJECT: PAPER V: THERAPEUTIC NUCLEAR MEDICINE PROCEDURES

Wednesday, June 05, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

✍ **Answer ALL the question.**

✍ **Long Questions:**

1. What are the non-target organs in a patient who has been given high dose of 131I? How will you decrease the radiation dose to the non target organs and tissues? With a neat diagram describe the "dual delay tank" system for 2 patients.

(20 marks)

2. A patient diagnosed to have multiple osteoblastic skeletal metastasis has been referred for pain palliation. Discuss the therapeutic radionuclides used for such patient.

(20 marks)

3. Describe in brief the different "Dose Strategies" to decide upon the dose of 131 I required to treat a patient suffering from thyrotoxicosis.

(20 marks)

**4. Short notes: Answer all**

4A. Patient preparation for 131 I low dose whole body scan.

4B. Radioimmunotherapy.

4C. Radionuclide therapy for polycythemia vera.

4D. TLD

(5×4 = 20 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2013

### SUBJECT: PAPER I: RADIO PHARMACY – II

Wednesday, December 18, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

**Answer all Questions.**

1. **Write in short about the following:**

1A. Miniature chromatography

1B. Centralized radio pharmacy

1C. Steam Sterilization

1D. 99mTc-Antibody

(5×4 = 20 marks)

2. Write the physical characteristics of Rb-82 generator. (No details)

3. Describe the kit composition and preparation protocol of any 99mTc- EC for renal tubule imaging agent.

4. What are the uses of lyophiliser and how?

5. Describe Bacterial Endo toxin Test (BET) for checking the radiopharmaceuticals.

(5×4 = 20 marks)

6. i) What are the precautions to be followed to minimize the radiation exposure to the staff during PET tracer handling?

   ii) Explain the role of reducing agents, Buffers, antioxidants and stabilizers in cold kits of 99mTc Radiopharmaceuticals.

(5+5 = 10 marks)

7. Write comparative description of any two radio iodination methods.

(10 marks)

8. Describe mode of uptake of following radiopharmaceuticals in different organs.

   i. 99mTc-Mebrofenin ii) 99mTc- Leukocyte

   iii) 99mTc- MDP iv) 99mTco4

(10 marks)

9. Describe the method of biological quality control with reference biodistribution parameter for checking the radiopharmaceuticals.

(10 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. N.M.T. DEGREE EXAMINATION – DECEMBER 2013

### SUBJECT: PAPER II: NUCLEAR MEDICINE INSTRUMENTATION – II

Thursday, December 19, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

✍ **Answer all questions.**

1. What are the quality control measures that should be adopted to assure the efficient working of a SPECT camera?

(20 marks)

2. What are the various types of events in annihilation coincidence detection? How will you separate each event and get the true events for calculation?

(20 marks)

3. Enlist the various radiation detectors used in Nuclear Medicine. Write on the principle of each with its application(s).

(20 marks)

4. **Write short notes on the following:**

4A. Photodiodes

4B. Calibration Sources

4C. Sample Volume Effect

4D. Dead time

(5×4 = 20 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2013

### SUBJECT: PAPER III: NON IMAGING NUCLEAR MEDICINE TECHNIQUES

Friday, December 20, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

✍. **Answer all the questions.**

1. A female patient is suffering from suspected H Pylori infestation. By a non- invasive procedure how will you confirm the presence of H Pylori in the patient's stomach?

(10 marks)

2. Write in detail about the Quality control of RIA.

(10 marks)

3. Write about the various separation systems used in RIA.

(10 marks)

4. A male patient suffering from Iron deficiency anemia has been referred to the department of Nuclear Medicine for a ferrokinetic study. Write in details the patient preparation and the procedure protocol for:

4A. Plasma iron clearance

4B. Iron utilisation

(10 marks)

5A. Calculate:

i) EF by using propagation of error concept

ii) Standard deviation using following data $N_{diastole} = 2000$, $N_{systole} = 1200$ and $N_{Bkg} = 400$. With 95.5% confidence.

5B. Explain types of Measurement error.

(5+5 = 10 marks)

6A. Which is the crucial characteristics of a good tracer?

6B. Explain single sample method for GFR calculation.

6C. Briefly explain the bi-exponential curve in measuring plasma concentration by administered DTPA.

(5+3+2 = 10 marks)

7. Why the patient is not placed as close to the detector face for the thyroid uptake study? Explain with the help of diagram/s.

(10 marks)

8. What is Quenching in liquid scintillation counting? Explain any one Quench correction method.

(10 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2013

### SUBJECT: PAPER IV: IMAGING NUCLEAR MEDICINE TECHNIQUES

Saturday, December 21, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

✍ **Answer all questions.**

✍ **Long Questions:**

1. A female patient has been referred to the dept. of Nuclear Medicine to rule out acute cholecystitis. Write about
   a) Patient preparation
   b) Radiopharmaceutical preparation
   c) Acquisition protocol
   d) Interpretation of the study

2. A male patient with a history of watering from the eyes of two years duration has been referred to the dept. of Nuclear Medicine for a dacryoscintigraphy. Write about
   a) Patient preparation
   b) Ideal pharmaceutical
   c) Acquisition protocol
   d) Interpretation of the study

3. A patient has been referred for the assessment of renovascular hypertension. Discuss the patient preparation and the imaging protocol with 99mTc-DTPA. Describe the renogram pattern with a tubular agent for a high probality renovascular hypertension.

(20×3 = 60 marks)

4. **Write short notes on:**

4A. Ideal pharmaceuticals for infection imaging
4B. Gall bladder ejection fraction
4C. Bone marrow imaging
4D. Lung perfusion imaging

(5×4 = 20 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2013

### SUBJECT: PAPER V: THERAPEUTIC NUCLEAR MEDICINE PROCEDURES

Monday, December 23, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

✍ **Answer ALL the question.**

✍ **Long Questions:**

1. Describe in brief the different "Dose Strategies" to decide upon the dose of 131 I required to treat a patient suffering from thyrotoxicosis.
2. Patient preparation and procedure protocol for 131I MIBG diagnostic scan.
3. A male patient has been referred to your department for radiation synovectomy of the knee joint.
   i) What are the ideal characteristics of the radionuclide/radiopharmaceutical which you will choose for this patient?
   ii) Enumerate five such agents along with their physical properties.
   iii) What are the future trends (newer pharmaceuticals/radionuclides) for radiation synovectomy?

(20×3 = 60 marks)

4. **Write short notes on:**

4A. Lay out plan for "Isolation Ward" for 131 I high dose therapy for carcinoma thyroid. (diagram only).

4B. Radionuclide therapy for recurrent malignant ascites

4C. Patient preparation for 131 I low dose whole body scan

4D. Radiopharmaceuticals used in hepatocellular carcinoma

(5×4 = 20 marks)

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# MANIPAL UNIVERSITY

## SECOND YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2013

### SUBJECT: PAPER VI: RADIATION BIOLOGY AND RADIATION PROTECTION

Tuesday, December 24, 2013

Time: 10:00 – 13:00 Hrs. Max. Marks: 80

- **Answer ALL questions.**
- **Students are instructed to answer Section – A and Section – B on the separate answer paper.**

## SECTION – A: RADIATION BIOLOGY (30 MARKS)

1A. Briefly explain how gamma radiation interacts with cells.

1B. Briefly explain the prenatal effects of radiation.

1C. Briefly explain the effects of radiation on chromosomes and chromatids.

(10×3 = 30 marks)

## SECTION – B: RADIATION PROTECTION ( 50 MARKS)

2. What are the regulatory clearances that are required for the nuclear medicine practice?

(5 marks)

3. Calculate the absorbed dose to the thyroidal gland of a hyperthyroid patient from a dosage of 15 mCi I – 131 assuming 65% uptake, biological half-life of 4 days for thyroid clearance of I – 131 and S = 2.2 E – 2 rad / μCi-hr

(5 marks)

4. Write in detail about transport of radioactive material.

(20 marks)

5A. Write in detail about beta ray dosimetry.

5B. Explain the three principles of Radiological protection. What is the annual dose limits prescribed by ICRP for occupational and public exposure. Do these include the exposures due to natural background radiation & medical exposure?

(10×2 = 20 marks)