

MANIPAL UNIVERSITY

**FIRST YEAR (M.Sc. MLT / M.Sc. NMT (NR) / M.Sc. MIT) / SECOND SEMESTER
M.Sc. HHIA DEGREE EXAMINATION – DECEMBER 2014**

**SUBJECT: BIOSTATISTICS/ PAPER IV – ADVANCED BIOSTATISTICS AND RESEARCH
METHODOLOGY/ BIOSTATISTICS/EPIDEMIOLOGY & BIOSTATISTICS**

Wednesday, December 17, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

✍ **Answer ALL the questions.**

1. List any two types of probability sampling? Describe any one of them in detail.
(1+4 = 5 marks)
2. Briefly explain various scales of measurement with suitable examples.
(5 marks)
3. Describe the concept of sampling distribution and standard error. In a study conducted on a sample of 1600 subjects, the prevalence of a particular condition was estimated to be 10%. Calculate 95% confidence interval for this estimate.
(5+5 = 10 marks)
4. Explain the rationale for and the concept of tests of significance. What are the steps involved in performing tests of significance.
(6+4 = 10 marks)
5. A team of cardiologists conducted a study to investigate the association between oral contraceptive use and hypertension. The results of the study are given below:

	Hypertensive	Normotensive	Total
Oral contraceptive	8	32	40
Other	15	45	60
Total	23	77	100

At 1% level of significance, do these data provide sufficient evidence to indicate the association between method of contraceptive use and hypertension? ($\chi^2_{1df}(0.01) = 6.64$)

(10 marks)

6. What are the requirements for calculating minimum sample size for estimating proportion and how they influence the required minimum sample size?

(5 marks)

7. Distinguish between:
- 7A. Case report and case series studies
 - 7B. Correlational and other descriptive studies
 - 7C. Incidence rate and prevalence rate
 - 7D. Relative risk and odds ratio
 - 7E. Retrospective and prospective study designs
- (10 marks)
8. A cohort study was conducted to find the effect of oral contraceptive (OC) use on breast cancer. Ten thousand women free from breast cancer were selected for the study and followed up for 10 years. Forty out of 8000 non users of OC and 14 out of 2000 OC users developed breast cancer. Calculate appropriate measure of strength of association and interpret the same.
- (5 marks)
9. Take a suitable example and explain the situation for the application of logistic regression.
- (5 marks)
10. In order to assess the validity of a test, it was applied on 100 individuals with a disease and 100 without the disease. The test resulted in a positive diagnosis for 80 out of those with disease and 10 of those without disease. Construct appropriate 2×2 table and calculate sensitivity, specificity, positive predictive value and negative predictive value of the test.
- (5 marks)
11. Explain the components of a scientific report.
- (10 marks)



MANIPAL UNIVERSITY

FIRST YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2014

SUBJECT: PAPER VII: RADIATION PHYSICS (NR)

Thursday, December 18, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

Answer ALL the questions.

1. “0.6616MeV is the $E_{\beta\max}$ of ^{137}Cs ”. Justify the above statement. Explain the decay mode of ^{137}Cs . Give its energy spectrum and applications in Nuclear Medicine.
2. **Write short note on:**
 - 2A. Semiconductor detector
 - 2B. Average life
3. Explain Rutherford’s and Bohr’s atom model. Also note the limitations of each model.
4. Write in detail about the Medical cyclotron mentioning its different parts.
5. What different parameters should be considered for the comparison of two different Scintillation detectors and Why?
6.
 - i) Describe the principle of gas filled detectors.
 - ii) Which instrument you will use for:
 - a) Survey of a Nuclear Medicine laboratory.
 - b) Spill of 1.85 MBq of $^{99\text{m}}\text{Tc}$. Give reasons in support of your answer.
7.
 - i) If a radionuclide decays with 10.34% per hour. What is the half-life and in what time it will decay to 10%?
 - ii) If the activity measured of $^{99\text{m}}\text{Tc}$ is 11.1 GBq on 10th April 2012 at 0900 hours. What was the activity on 10th April 2012 at 0600 hours and what will be the activity on 11th May 2012 at 1200 hours?
8. Explain the various mechanisms of gamma ray interaction. Does it depend on atomic number of the interacting material? How these interactions are affected by the energy of the incident radiation?

(10 marks \times 8 = 80 marks)



MANIPAL UNIVERSITY**FIRST YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2014****SUBJECT: PAPER VIII: RADIOPHARMACY – I**

Friday, December 19, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

☞ Answer ALL the questions.**1. Write short notes on:**

- 1A. Radiopharmaceutical
- 1B. Tc^{99m} -Technegas
- 1C. pH and Ionic Strength
- 1D. Colloidal solution
- 1E. Positive and negative ion formation
- 1F. Metastable state
- 1G. Distillation
- 1H. Buffer Solutions
- 1I. Nucleons
- 1J. Crystallization

(2 marks \times 10 = 20 marks)

2. Explain with examples Transient and Secular Equilibrium.

(5 marks)

3. List reactor – produced radionuclides.

(5 marks)

4. A 50mCi Tc^{99m} -DISIDA sample contains 5uCi Mo^{99} . If a patient is to be injected with 5mCi Tc^{99m} -DISIDA for Hepatobiliary studies 6hr later, can you administer this radiopharmaceutical to the patient?

(5 marks)

5. Compare and contrast between ^{99m}Tc PYP Vs ^{99m}Tc Diphosphonates.

(5 marks)

6. Describe the methods of sterilisation and sterility testing for a radiopharmaceutical sample.

(10 marks)

7. List the differences between traditional paper chromatography and miniature chromatography? How to calculate R_f value and Radiochemical purity of radiopharmaceuticals with traditional paper chromatography?

(10 marks)

8. What makes F18 a indispensable radionuclide in PET imaging.

(10 marks)

9. Explain radionuclide generator systems.

(10 marks)



MANIPAL UNIVERSITY
FIRST YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2014
SUBJECT: PAPER IX: NUCLEAR MEDICINE INSTRUMENTATION – I

Saturday, December 20, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

✍ Answer ALL the questions.

✍ Draw neat and labeled diagram as and when required.

1. Elaborate on the working principle of analogue to digital converters used for the analysis of the pulses generated from solid and liquid scintillation counters. Also add a note on the settings adopted in both the counters.
(20 marks)
2. Describe the working principle of the gamma probe used for parathyroid adenoma localization.
(20 marks)
3. “Resolution and sensitivity of rectilinear scanner do not influence the detectability of a lesion.” – opine. Explain how resolution can be measured quantitatively?
(10 marks)
4. Write a note on sample volume effect in radiation detection instruments.
(10 marks)
5. Explain sleeve method and graded source method linearity tests adopted in dose calibrator.
(10 marks)
- 6A. Explain the counting statistics use in handling the spectrometer.
- 6B. Radioactivity source was counted 10 times and mean of that was 1991cpm. Standard deviation of total counting calculated by normal distribution is 130. Find the counter error.
(5+5 = 10 marks)



MANIPAL UNIVERSITY

FIRST YEAR M.Sc. N.M.T. DEGREE EXAMINATION – DECEMBER 2014

SUBJECT: PAPER III: MATHEMATICS IN NUCLEAR MEDICINE

Wednesday, December 24, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

✍ Answer any EIGHT questions of the following:

1A. Find the second derivative of the $6x^3 + 3x^2 + 2x + 5$

1B. Find the equation of tangent and normal to the following curves at given point:

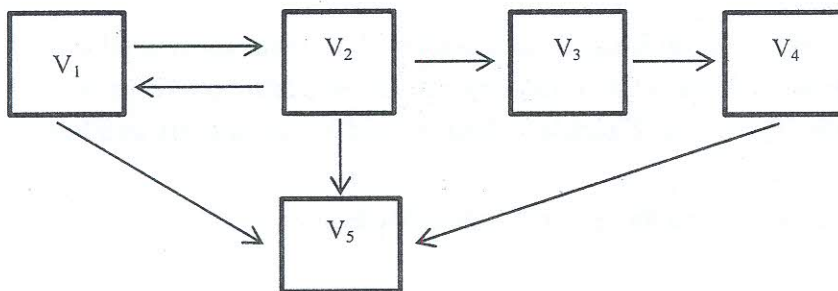
$$2x^3 - 9xy + 2y^3 = 0 \text{ at } (2, 1)$$

1C. Convert 3 GBq activity into mCi

(3+5+2 = 10 marks)

2A. Evaluate: $\int \frac{2x+1}{x^2-3x+2} dx$

2B. Write the Mathematical Model equation for the following tracer kinetic compartment:



(5+5 = 10 marks)

3A. What would be the radiation level at 10cm from 10 MBq source of Co-57?

(k factor = 0.2mGy/h/MBq at 1cm)

3B. 500mCi of I-131 is kept at 1metre distance. How long a person can sit at 1 mtr distance for getting 20 mSv?

3C. Explain dot product and cross product.

(3+5+2 = 10 marks)

4A. $A = \begin{bmatrix} 1 & 3 \\ 4 & 7 \end{bmatrix}$ $B = \begin{bmatrix} 0 & 2 \\ 5 & 6 \end{bmatrix}$ Show that $AB \neq BA$.

4B. Express the complex number: $\frac{-3}{2} - \frac{-1}{2}i$ in the polar form and find their modulus and amplitude.

4C. Explain log-log graph.

(4+4+2 = 10 marks)

5A. Differentiate: $y = \sin(ax + b)$.

5B. Find the maxima and minima of the function $2x^3 - 12x^2 + 18x + 5$.

5C. Evaluate: $\int \cos^2 x dx$

(2+5+3 = 10 marks)

- 6A. Write a short note on Fourier transformation and inverse Fourier transformation used in Nuclear Medicine.
- 6B. Find the second derivative of the $12x^3 + 4x^2 - 2x + 5$.
- 6C. The activity of Tc-99m at the time of disposal in lead dustbin was 0.8 mCi. What is the activity after 10 days?

(4+3+3 = 10 marks)

- 7A. Evaluate: $\int (x^2 - 2x + 3)^7 (x - 1) dx$
- 7B. Find the scalar product of the vectors $a = 2i - 2j + k$, $b = 2i - 3j + 6k$. Also find the cosine of the angle between a and b.
- 7C. Write a short note on Newton's interpolation and its use in Nuclear medicine.

(3+4+3 = 10 marks)

- 8A. If $\operatorname{cosec} A = -13/12$ and $180 < A < 270$ find the value of $\frac{4 \sin A + \cos A}{8 \sin A + 2 \cos A}$

8B. Solve: $\lim_{x \rightarrow \infty} \frac{(5x+1)(8x+4)}{(x+1)(x+7)}$

- 8C. Write a short note on Simpson's one-third rule and Simpson's three-eighth rule.

- 8D. Define onto, one-to-one function, even function, odd function.

(2+2+4+2 = 10 marks)

- 9A. 650 mCi of I-131 is available on Monday at 12 noon. 2 patients are treated with 100mCi and 75 mCi on the same day. What is the remaining activity available on Thursday at 11 am? One patient is treated with 100mCi on Thursday. What would be the activity available on Saturday at 10 am?

- 9B. Write a short note on matrix and the use in Nuclear Medicine.

(5+5 = 10 marks)



MANIPAL UNIVERSITY

FIRST YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2014

SUBJECT: PAPER V: COMPUTERS IN NUCLEAR MEDICINE

Friday, December 26, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

☞ **Answer ALL the questions.**

1. What are Computers and write in detail about the classification and generation of computers. (10 marks)
2. What is memory and explain the various types of memory. Compare and contrast between RAM and ROM. (15 marks)
3. “During image acquisition byte mode acquisition is always preferred compared to word mode acquisition”. Justify the statement with example(s). (5 marks)
4. What is an ADC? Explain on any one ADC used in Nuclear Medicine. What are the characteristics of such ADCs? (10 marks)
5. Explain network topologies. (5 marks)
6. Explain the structure of C program with suitable example. (5 marks)
7. Write in detail about time activity curve and curve smoothing. (10 marks)
8. **Define the following:**

i) Variable	ii) Network	iii) Identifier
iv) Bus	v) Software	

(2 marks × 5 = 10 marks)

9. A female patient presented with symptoms of thyrotoxicosis was administered 3mCi of ^{99m}Tc-sodium pertechnetate intravenously. From the following data calculate the percentage uptake of the radiopharmaceutical in the thyroid.

Parameter	Count (cpm)	Number of Pixels
Pre-injection Syringe	677850	400
Post-injection Syringe	2000	400
Thyroid ROI	56983	1000
Bkg ROI	848	204

(5 marks)

10. How selection statements are helpful in decision making? (5 marks)



MANIPAL UNIVERSITY**FIRST YEAR M.Sc. NMT DEGREE EXAMINATION – DECEMBER 2014****SUBJECT: PAPER VI: BIOMEDICAL ELECTRONICS**

Saturday, December 27, 2014

Time: 10:00 – 13:00 Hrs.

Max. Marks: 80

✍ Answer ALL the following questions.

✍ Draw suitable circuit diagram, block diagram, waveform or characteristics wherever it is necessary.

1A. Explain Inductor and Transistor.

1B. Explain the atomic structure of semiconductor.

1C. Explain MOSFET.

(3+3+4 = 10 marks)

2A. Explain Zener diode.

2B. Explain the doping in semiconductor.

2C. Explain Voltage Regulator type of Power supply.

(3+3+4 = 10 marks)

3A. Explain the quality of amplifier.

3B. Explain the half-wave rectifier.

3C. Explain voltage sensitive pre-amplifier.

(4+3+3 = 10 marks)

4A. Explain amplitude distortion in amplifier.

4B. Write a short note on Noise produced in electronic equipments.

4C. What is equivalent circuit and explain Thevenin Equivalent circuit.

(3+3+4 = 10 marks)

5A. What is transducer and explain on the transducer used in Nuclear Medicine.

5B. Explain Differentiator op-amp and Integrator op-amp.

(5+5 = 10 marks)

6A. Explain the classification of filters.

6B. Explain the UPS.

(5+5 = 10 marks)

7A. Explain the coincidence circuit, anti-coincidence circuit. Add a note on their use in Nuclear Medicine.

7B. Write a short note on ADC and DAC.

(5+5 = 10 marks)

8A. Explain AND, OR and NOT gate.

8B. What is the use of Boolean Algebra?

8C. Find $(111011)_2 + (111011)_2 + 100010_2$; $(1001001)_2 \times (101)_2$ and convert the answer into decimal.

(4+2+4 = 10 marks)

