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MANIPAL UNIVERSITY

SECOND YEAR B.Sc. N.M.T. DEGREE EXAMINATION – JUNE 2015

SUBJECT: RADIATION CHEMISTRY AND RADIATION PHYSICS

Monday, June 15, 2015

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

✍ **Answer Section – 'A' and Section – 'B' in two Separate Answer Books.**

SECTION – A : RADIATION CHEMISTRY : 30 MARKS

1. **Write notes on following:**

1A. PH meter and PH indicator

1B. Limitation of Rutherford's atomic model

1C. Exothermic and endothermic Chemical reactions

1D. Atomic weight and equivalent weight

(5 marks × 4 = 20 marks)

2. Describe Dative bond and Coordinate Covalent bond formation with examples.

(10 marks)

SECTION – B : RADIATION PHYSICS : 50 MARKS

✍ **Answer all the questions. Draw neat and labelled diagram as and when required.**

1. Explain the various atomic models with its merits and demerits.

(8 marks)

2A. Derive exponential law of radioactive decay.

2B. ^{131}I consignments despatched from the company on Monday 11th morning reached your department on the following Tuesday 12th at 8 hours. The packing note stated 5 vials of ^{131}I, each of 7.4GBq in 2 ml at 17 hours on Wednesday the 13th. As RSO how would you dispense the dose for the following listed patients of the same week? List each dose into the traditional unit too.

Patient ID	Age	Dose (MBq)	Purpose	Appointment Date
A	28y/F	3700	Ablation Therapy	12th, Tuesday
B	57y/M	9250	Ablation Therapy	12th, Tuesday
C	33y/F	1850	Ablation Therapy	14th, Thursday
D	78y/M	555	Ablation Therapy	15th, Friday
E	90y/M	2800	Ablation Therapy	14th, Thursday
F	40y/M	3300	Ablation Therapy	13th, Wednesday
G	40y/F	2294	Ablation Therapy	13th, Wednesday

(8+10 = 18 marks)

3. Write a short note on collisional and radiation losses.

(3 marks)

4. Explain on quenching and its corrective measures adopted in GM counters.

(7 marks)

5A. Draw neat, labelled and detailed energy spectrum of ^{99m}Tc and explain on each peak.

5B. Prove for ^{99m}Tc radionuclide the energy of recoil electron for 180^{o} Compton scattering interaction is 49keV.

(5+3 = 8 marks)

6. List the various methods for the production of radionuclides with examples.

(6 marks)

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SECOND SEMESTER B.Sc. N.M.T. DEGREE EXAMINATION – JUNE 2015

SUBJECT: NMT 102 - PAPER I: MATHEMATICS IN NUCLEAR MEDICINE

Tuesday, June 16, 2015

Time: 10.00-13.00 Hrs. Max. Marks: 80

Answer any EIGHT questions of the following:

1A. Define radian. Convert 45°,75° to radian and $(¾)^c$, $(2/5)^c$ to degree.

1B. Prove that: $\sqrt{\sec^2 A + \operatorname{cosec}^2 A} = \tan A + \cot A$

1C. If a radionuclide decays with 10.34% per hour. What is the half-life and in what time it will decay to 10%?

(2+3+5 = 10 marks)

2A. Explain the graph of Log-log and its use in Nuclear Medicine.

2B. Solve the differential equation: $\frac{dy}{dx} + xy = xy^2$

2C. Find the maxima and minima of the function $x^3 - 18x^2 + 96x + 4$

(2+3+5 = 10 marks)

3A. Find derivative of: $x^4 - 3x^3 + 2x + 7$ with respect to x

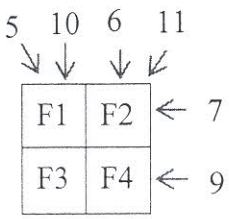
3B. Evaluate: $\int (x^2 - 2x + 5)^5 (x - 1)\ dx$

3C. Explain Fourier transformation used in image reconstruction

(2+3+5 = 10 marks)

4A. Find the equation of tangent and normal to the curve $y = 3x^2 - 5x + 6$ at point (2, 8).

4B. Find the values of 4 pixels from the provided 6 bin values using the method of algebraic reconstruction technique.



(3+7 = 10 marks)

5A. Define onto and one-one function with one example each.

5B. Differentiate $y = x\sin^2(e^x)$ with respect to x.

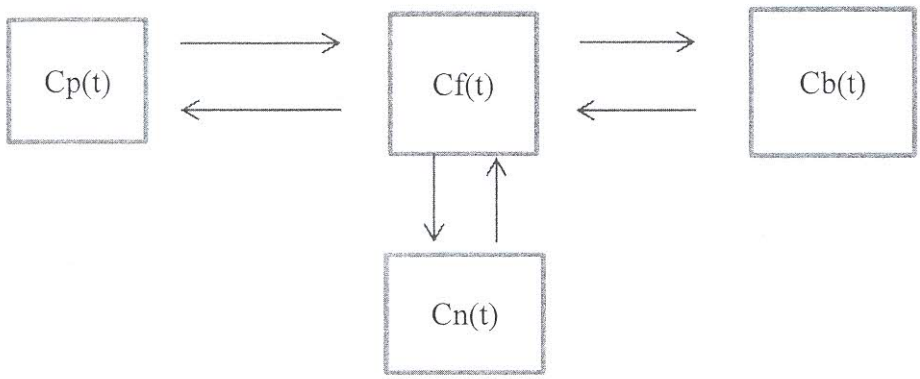
5C. Solve: $\lim_{x \to \infty} \frac{(3x+1)(2x+4)}{(x+1)(x+7)}$

5D. A radiation level of 5R/h has to be brought down to 2.5 mR/h. What is the shielding requirement in terms of HVT and TVT?

(2+3+2+3 = 10 marks)

6A. Evaluate: $\int \frac{3x-2}{(x+1)(x^2+4)}\, dx$

6B. Write the Mathematical Model equation for the following tracer kinetic compartment.



(5+5 = 10 marks)

7A. Evaluate : $\int_1^2 (x^2 + 1)\, dx$

7B. Form differential equation by eliminating the arbitrary constant 'a': $ay^2 = x^3$

7C. Convert 300 mCi into GBq.

7D. 140 mCi of MDP - Tc-99m is available in 4ml. Calculate the volume if you want to withdraw 25mCi from that vial.

(2+3+2+3 = 10 marks)

8A. 600mCi of I-131 calibrated for Monday 12 noon reaches the department at 8am. Two patients are scheduled for treatment on the same day with a dose of 100 mCi each. At 10 am on the following Saturday how much activity would be remaining? ($t_{½}$ = 8 days)

8B. Half-life of a radioactive element is 110 mins. Biological half-life is 24 hours. What is the effective half-life, mean half-life of the radionuclide?

(5+5 = 10 marks)

9A. Calculate the exposure rate at one meter from a Caesium -137 source of activity 0.1 GBq (It may be assumed that 86% of the transformation in associated with the emission of 0.66MeV gamma Photons.

9B. Prove that: log 81/8 - 2 log 3/2 + 3 log 2/3 + log ¾ = 0

9C. Explain the Newton's interpolation formula and where do we use this in Nuclear Medicine.

(3+3+4 = 10 marks)

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SECOND YEAR B.Sc. N.M.T. DEGREE EXAMINATION – JUNE 2015

SUBJECT: RADIOPHARMACY – I

Wednesday, June 17, 2015

Time: 10:00-11:30 Hrs. Max. Marks: 40

✍ **Answer ALL questions.**

1A. Briefly explain on the radiation safety measures taken in radiopharmacy lab.

1B. Describe secular and transient equilibrium with examples.

1C. What is radiochemical impurity? How it arises? List various methods to check these impurities.

1D. What is the most common reducing agent used in Tc99m-labeling and how it acts?

(5 marks × 4 = 20 marks)

2. Explain in detail the construction of Moly-Technetium generator and list its advantages and disadvantages. What are the most prevalent impurities / contaminants in this type of generator?

(10 marks)

3A. A radioactivity sample of F^{18} contains 370MBq of activity at 9:00 a.m. What will be the radioactivity of this sample at 3:00 p.m on same day?

3B. If this F^{18} vial gives an exposure of 10mR/Hr at 1 meter distance, what will be the exposure at 10cm?

3C. A vial containing Tc^{99m}-DTPA was formulated at 8:00 a.m. having specific concentration "2mCi/ml". What volume should be withdrawn at 4 p.m. on the same day to dispense the dose for a child of age one year and six months?

(3+3+4 = 10 marks)

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SECOND SEMESTER B.Sc. N.M.T./B.Sc. M.I.T./BACHELOR OF CLINICAL OPTOMETRY/ BACHELOR OF PERFUSION TECHNOLOGY DEGREE EXAMINATION – JUNE 2015

SUBJECT: BIOCHEMISTRY (NMT 106) / BIOCHEMISTRY (MIT 106) / BASIC BIOCHEMISTRY (BOP 104) / BIOCHEMISTRY II (PFT 104)

Thursday, June 18, 2015

Time: 10.00-11.30 Hours Max. Marks: 40

✍ **Answer ALL questions.**

1. Write in detail the reactions of anaerobic glycolysis and add a note on its energetics.

(8 marks)

2. Describe in detail the process of ketogenesis and ketolysis.

(3+3 = 6 marks)

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

3A. Arrangement of complexes and their components in the electron transport chain

3B. Effect of substrate concentration and pH on enzyme activity with the help of graphs

3C. Classification of monosaccharides with examples

3D. Structure of DNA

(4 marks × 4 = 16 marks)

4. **Answer the following:**

4A. Write the isoenzymes of creatine kinase and mention its clinical importance.

4B. Define limiting amino acid with an example.

4C. List four functions of vitamin C.

4D. Write the normal levels of urea, cholesterol, bilirubin and creatinine.

4E. Define and give one example each for endopeptidase and exopeptidase.

(2 marks × 5 = 10 marks)

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SECOND YEAR B.Sc. N.M.T. DEGREE EXAMINATION – JUNE 2015

SUBJECT: FUNDAMENTALS OF ELECTRONICS & NUCLEAR MEDICINE INSTRUMENTATION

Friday, June 19, 2015

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

✍ **Answer SECTION – A and SECTION – B in two separate answer books.**

SECTION – A : FUNDAMENTALS OF ELECTRONICS : 30 MARKS

✍ **Answer ALL the following questions.**

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

1A. Explain voltage sensitive pre-amplifier.

1B. Explain different types of DAC.

(2+3 = 5 marks)

2A. Explain the voltage follower OP-amp.

2B. Explain the charge sensitive pre-amplifier.

(2+3 = 5 marks)

3A. Define filters and write the types of filters.

3B. Explain p-n-p transistor.

(2+3 = 5 marks)

4A. Explain pulse shaping.

4B. Explain ideal and real Op-amp.

(2+3 = 5 marks)

5A. Explain OR gate with simple circuit.

5B. Explain the resistors connected in parallel and series.

(2+3 = 5 marks)

6. Briefly explain the different types of power supply.

(5 marks)

SECTION – B: NUCLEAR MEDICINE INSTRUMENTATION: 50 MARKS

✍ **Answer ALL the questions.**

1. **Give reasons for the following:**

1A. Edge packing in Anger Camera

1B. Usage of PMT in Rectilinear Scanner

1C. Broadening of the Photopeak in Gamma Ray Spectrum

1D. The apparent activity of a dose will vary with the volume and shape of the container and the position of the dose within the chamber of dose calibrator

(5 marks × 4 = 20 marks)

2. Explain the various QC tests of a planar Gamma Camera.

(20 marks)

3. **Write short notes on:**

3A. Dot Factor

3B. Molybdenum breakthrough measurements in dose calibrator

(5 marks × 2 = 10 marks)

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SECOND SEMESTER B.Sc. N.M.T. DEGREE EXAMINATION – JUNE 2015

SUBJECT: NMT 104 - PAPER II: NUCLEAR MEDICINE INSTRUMENTATION-I

Saturday, June 20, 2015

Time: 10.00-11.30 Hrs. Max. Marks: 40

✍ **Answer ALL questions. Draw neat and labelled diagram as and when required.**

1. Radiopharmacist in your lab observed that during formulations when large amount of activity is dispensed the readings are fine but when paediatric doses are dispensed he is not so confident. As a physicist what are the tests you should adopt to rule out the issue.

(10 marks)

2. What is the requirement of a preamplifier in gamma ray spectrometer? How does it function?

(3+7 = 10 marks)

3. List three different types of energy sensitive radiation detectors and briefly explain the working of any one of them.

(2+3 = 5 marks)

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

4A. Test of Constancy

4B. Test of sensitivity

4C. Transducer

(5 marks × 3 = 15 marks)

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SECOND SEMESTER B.Sc. N.M.T./FOURTH SEMESTER BACHELOR OF CLINICAL OPTOMETRY & BACHELOR OF PERFUSION TECHNOLOGY DEGREE EXAMINATION – JUNE 2015

SUBJECT: BASIC BIOSTATISTICS AND RESEARCH METHODOLOGY (NMT 108)/ RESEARCH METHODOLOGY AND BIOSTATISTICS (BOP 212/PFT 210)

Tuesday, June 23, 2015

Time: 10:00-11:30 Hrs. Max. Marks: 40

1. Describe the role of statistics in clinical medicine.

(5 marks)

2. Define qualitative and quantitative variable with an example each.

(3 marks)

3. Categorize the following based on scales of measurement (Nominal, Ordinal, Interval and Ratio):

a) Age b) Temperature (°C) c) Pain Score d) Hospital Number

(4 marks)

4. List out any four properties of the normal distribution curve.

(2 marks)

5. Write a note on systematic Sampling.

(4 marks)

6A. Given below is the number of casualties received by a trauma center in a 10 hour period. Compute the mean, variance and coefficient of variation of the number of casualties.

22 16 24 31 27 22 14 18 20 6

6B. Find the median, range and the interquartile range for the following data regarding the number of patients visiting a doctor's clinic on 10 days:

12 16 17 10 11 12 15 19 16 13

(6 marks × 2 = 12 marks)

7. Form a frequency table along with relative frequencies for the ages of 48 patients given below. (Class intervals: 0 – 15, 15 – 30, 30 – 45, so on)

47	33	46	17	38	10	36	29	40	22	40	65
32	36	42	76	50	30	34	25	36	39	36	42
15	30	39	53	47	64	31	07	39	43	62	30
32	39	24	57	37	47	27	43	43	54	40	39

(5 marks)

8. Construct a frequency polygon for the following data regarding serum cholesterol (mmol/L) levels measured on a sample of 86 stroke patients:

Interval	Frequency
3.0 - 4.0	3
4.0 - 5.0	11
5.0 - 6.0	24
6.0 - 7.0	20
7.0 - 8.0	19
8.0 - 9.0	5
9.0 - 10.0	2
10.0 - 11.0	2

(5 marks)