Reg. No.									

MANIPAL UNIVERSITY

FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2015

SUBJECT: PAPER I: BASIC MEDICAL SCIENCES (ANATOMY & PHYSIOLOGY)

Thursday, January 01, 2015

Time: 10:00 – 13:00 Hrs. Max. Marks: 60

- **Answer both Section 'A' and 'B' in TWO Separate Answer Books.**
- **Answer ALL questions. Draw diagrams wherever necessary.**

SECTION – A: ANATOMY: 40 MARKS

1. Name the parts of the male reproductive system. Describe the testis.

(5+5 = 10 marks)

2. **Write short notes on the following questions:**

2A. Classification of synovial joints
2B. Larynx
2C. Internal capsule
2D. Right atrium
2E. Pituitary gland
2F. Anal canal

(5 marks × 6 = 30 marks)

SECTION – B: PHYSIOLOGY: 20 MARKS

3. **Essay questions:**

3A. Define cardiac output. Give its normal value. Mention any three conditions where cardiac output is increased.
3B. In the form of a flow chart, write the steps involved in the intrinsic and extrinsic mechanisms of blood coagulation.

(5 marks × 2 = 10 marks)

4. **Write short answers for the following**:

4A. List two differences between two kinds of photoreceptors of the eye
4B. Define the terms 'cyanosis' and 'asphyxia'
4C. List two differences between red and white skeletal muscle fibers
4D. Explain facilitated diffusion with an example
4E. State Landsteiner's law

(2 marks × 5 = 10 mark)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2015

SUBJECT: PAPER II: MATHEMATICAL METHODS IN PHYSICS

Saturday, January 03, 2015

Time: 10:00 – 13:00 Hrs. Max. Marks: 100

✍ **Answer ALL the questions.**

1A. Define the following with an example:
- i) Constant function
- ii) Identity function
- iii) Polynomial function
- iv) Exponential function

1B. Solve equations algebraically $6x^2 + 2x = 4$ and $12x^2 + 8x = 3$.

1C. Show that $\lim_{x\to 0} \frac{tanx}{x} = 1$.

(6+4+5 = 15 marks)

2A. Evaluate the following limits:
- i) $\lim_{x\to 0} \frac{cos(a+x)-cos(a-x)}{x}$
- ii) $\lim_{x\to 1}(1-x)tan\left(\frac{\pi}{2}x\right)$
- iii) $\lim_{x\to -1} \frac{x^9+1}{x^{14}-1}$

(4+5+6 = 15 marks)

2B. Find the derivatives of the following functions:
- i) $sin^{-1}\left(\frac{2x^2}{1-x^4}\right) + sec^{-1}\left(\frac{1-x^4}{2x^2}\right)$
- ii) $sin\left[msin^{-1}\left(\sqrt{x}\right)\right]$

(6+6 = 12 marks)

2C. Evaluate the following integrals:
- i) $\int_1^4 \frac{x^2+2x+5}{x\sqrt{x}}\,dx$
- ii) $\int_1^2 \frac{e^x}{e^x+e}\,dx$

(8+6 = 14 marks)

3A. Find the Laplace transform for the functions $t^2e^{-t}sin3t$.

3B. Evaluate the following integrals:
- i) $\int_0^{\frac{\pi}{2}} \sqrt{tanx}\,dx \cdot \int_0^{\frac{\pi}{2}} \sqrt{cotx}\,dx$
- ii) $\int_0^{\infty} \frac{e^{-t}sint}{t}\,dt$

3C. Solve using Laplace transform the equation $y'' - 8y' + 15y = 9te^{2t}$ given $y(0) = 5$ and $y'(0) = 10$.

(4+5+5+5 = 19 marks)

4A. Find the stationary values of $x^2 + y^2 + z^2$ subject to condition $xy + yz + zx = 3a^2$.

4B. Find the possible percentage error in computing the resistance r from the formula $\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$ where r_1 and r_2 are both in error by 2% each.

(5+5 = 10 marks)

5A. In a condenser discharging electricity, the voltage v satisfies the equation $k\left(\frac{dv}{dt}\right) + v = 0$ where k is a constant and t is the time measured in seconds. Given $k=50$, find the time t in which v decreases to one tenth of its original value.

5B. Solve the following differential equations:

i) $(1 - x^2)\frac{dy}{dx} + xy = y^3 sin^{-1}x$

ii) $\frac{dy}{dx} = e^{2x-y} + x^3 e^{-y}$

(5+5+5 = 15 marks)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2015

SUBJECT: PAPER III: ELECTRONICS

Monday, January 05, 2015

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

- **Answer ALL the questions.**
- **Any missing data may be assumed suitably.**

PART – A

1. **Answer the following:**

1A. Discuss the classification in resistors and capacitors.

1B. Discuss the use of a CRO for measurement of voltage, phase angle and frequency.

1C. Explain the construction and working of Schottky diode with proper diagrams.

1D. Explain the working principle of parallel resonant circuit using suitable circuit diagram and graph.

1E. Discuss the working of integrator using op-amp.

1F. Write a note on potentiometric displacement transducer.

1G. Draw and explain the V-I characteristics of n-channel JFET.

1H. Describe the Hall effect with suitable diagram.

(5 marks × 8 = 40 marks)

PART – B

2. **Answer the following:**

2A. Draw the block diagram of CRO. Discuss the functions of each part.

2B. Derive the expressions for voltage gain and input resistance using ac equivalent of CE amplifier circuit.

2C. Classify and explain ICs depending on method of fabrication of ICs.

2D. i) Write a note on diffusion current in p-type semiconductor.

ii) Density of free electrons in pure germanium at 300K is 2.4×10^{19}electrons/m^3. Determine the resistance of a bar of germanium 1mm×2mm and 10mm long. Given $\mu_n=0.39$; $\mu_p=0.19$; $q=1.6\times10^{-19}$C.

2E. With the block diagram explain the working of regulated power supply.

(8 marks × 5 = 40 marks)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2015

SUBJECT: PAPER IV: MODERN PHYSICS

Wednesday, January 07, 2015

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

- **Answer ALL questions.**
- **Any missing data may be assumed suitably.**

Physical Constants:

Speed of light in vacuum, $c = 3 \times 10^8$ m/s	Planck's constant, $h = 6.626 \times 10^{-34}$ Js
Atomic mass unit, $u = 1.67 \times 10^{-27}$ kg	Electron mass, me $= 9.11 \times 10^{-31}$ kg
Proton mass, $m_p = 1.67 \times 10^{-27}$ kg	Neutron mass, $m_n = 1.67 \times 10^{-27}$ kg
Electronic charge, $e = 1.602 \times 10^{-19}$C	$1\ eV = 1.602 \times 10^{-19}$J

1A. Write a note on *basic laws of radiation*. Discuss the inadequacy of classical electromagnetic theory in explaining *Photoelectric Effect*. How did Einstein explain this?

1B. What is a *wave packet*? Write a note on *phase velocity* and *group velocity*. Obtain a relation between phase velocity and group velocity. Show that group velocity of matter wave is equal to particle velocity.

1C. A free electron has a wave function $\psi(x) = Ae^{5\times10^{10}ix}$, where x is measured in metre. Determine the:

i) de-Broglie wavelength of the electron

ii) Momentum of the electron

iii) Energy of the electron in eV.

(6+6+4 = 16 marks)

2A. Establish Schrodinger's equation for a particle penetrating through a *rectangular potential barrier* by quantum mechanical tunnelling and solve it to obtain the reflection and transmission coefficients.

2B. Write a note on mass and *binding energy* of the nucleus. What is the significance of neutron-proton (n/p) ratio? Explain nuclear spin and parity.

2C. A quantum particle confined in a one dimensional box of width L is in its first excited state. What is the probability of finding the particle over an interval of $L/2$ marked symmetrically at the centre of the box?

(6+6+4 = 16 marks)

3A. Discuss the *magnetic moment* and *quadrupole moment* of the nucleus. Explain how the quadrupole moment measures the spherical symmetry of the nucleus.

3B. Discuss the salient features of *beta ray spectra* and explain how *Pauli's hypothesis of neutrino* emission solved the anomalies in the beta ray spectra. State the properties of neutrino.

3C. The half-life of the radioactive nucleus is $^{226}_{88}Ra$ is 1600 years.

i) What is the decay constant λ for this nucleus?

ii) If a sample contains 3×10^{16} $^{226}_{88}Ra$ nuclei at $t = 0$, then determine its activity (in curie) at this time.

iii) What is the activity after the sample is 2000 year old?

(6+6+4 = 16 marks)

4A. Discuss the general characteristics of *nuclear force*. Explain *Yukawa's* theory of nuclear forces. How it explains the anomalous magnetic moment of the nucleus?

4B. Describe the construction and working of GM *Counter*.

4C. Calculate the Q-value for $^{19}F(p, a)^{16}O$ nuclear reaction when the atomic masses of Fluorine, Oxygen, Helium and Proton are $18.998403u$, $15.994915u$, $4.002602u$ and $1.007825u$ respectively.

(6+6+4 = 16 marks)

5A. Explain briefly the *shell model* of the nucleus.

5B. Obtain the expressions for *Q-value* and *threshold energy* of nuclear reaction in laboratory system.

5C. Light of wavelength 180nm ejects photoelectrons from a plate of metal whose work function is 2eV. If a magnetic field of intensity 5×10^{-5}T is applied parallel to the plate, what would be the radius of the path followed by the electron ejected normally from the plate with maximum energy?

(6+6+4 = 16 marks)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2015

SUBJECT: PAPER V: FUNDAMENTALS OF COMPUTERS AND COMPUTER PROGRAMMING

Friday, January 09, 2015

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

Answer any FIVE full questions.

1A. Explain the working of a digital computer with a block diagram.

1B. Give the classification of digital computer systems and explain each of them.

(8+8 = 16 marks)

2A. Convert the following binary number into decimal number and octal number:

i) 11111 ii) 100111

2B. Convert the following hexadecimal numbers into decimal:

i) CA13 ii) B1A2

(8+8 = 16 marks)

3A. What is ROM? What are the different types of ROM?

3B. Explain the working of: i) Keyboard ii) MICR

(8+8 = 16 marks)

4A. Differentiate between the following:

i) ROM and RAM

ii) Compilers and Interpreters

iii) Impact and non impact printers

4B. Explain the various functions of an operating system.

(9+7 = 16 marks)

5A. Explain any four network topologies.

5B. What is data? What are the features of DBMS software?

(8+8 = 16 marks)

6A. Write a C program to generate the fibonacci series between two given limits.

6B. Write a C program to search for an element in a given array by Linear Search method.

(8+8 = 16 marks)

7A. With a neat block diagram explain the fundamental steps in Digital Image Processing.

7B. What is Image Compression? Explain any 2 techniques of Image Compression?

(8+8 = 16 marks)