Reg. No.									

MANIPAL UNIVERSITY

FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2014

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

Wednesday, January 01, 2014

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 female reproductive system. Describe the relations and blood supply of uterus.

(4+4+2 = 10 marks)

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

2A. Arteries
2B. Cavity of larynx
2C. Anal canal
2D. Vas deferens
2E. Corpus striatum
2F. Superior mediastinum

(5×6 = 30 marks)

SECTION – B: PHYSIOLOGY: 20 MARKS

3. **Essay questions:**

3A. Draw a neat labeled diagram of oxygen hemoglobin dissociation curve. Enumerate the factors shifting the curve to the right.

3B. Define erythropoiesis. List the stages of erythropoiesis. Write a note on regulation of erythropoiesis.

(5×2 = 10 marks)

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

4A. Name the receptor for hearing and mention its location.
4B. Write two differences between myelinated and unmyelinated nerve fibers.
4C. Define arterial blood pressure. Give its normal value.
4D. Define sarcomere. Draw a neat labeled diagram of a sarcomere.
4E. Explain facilitated diffusion with an example.

(2×5 = 10 marks)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2014

SUBJECT: PAPER II: MATHEMATICAL METHODS IN PHYSICS

Friday, January 03, 2014

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

Answer ALL the questions.

1A. Define a function. Solve equations graphically $y = 3 - x$ and $y = e^{x-1}$.

1B. Show that $\lim_{x\to 0} \frac{\sin x}{x} = 1$

(6+6 = 12 marks)

2A. Evaluate the following limits:

i) $\lim_{x\to\infty} \sqrt{x^2+x+1} - \sqrt{x^2+1}$ ii) $\lim_{x\to\frac{\pi}{2}} \frac{1-\sin x}{\frac{\pi}{2}-x}$

2B. Evaluate the following integrals:

i) $\int_0^{\pi} \frac{x \sin x}{1+\cos^2 x}\,dx$ ii) $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\tan x}}{\sqrt{\tan x}+\sqrt{\cot x}}\,dx$ iii) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{dx}{5+7\cos x+\sin x}$

2C. Find the derivatives of the following functions:

i) $y = (x)^{\cos x} + (\cos x)^{\sin x}$ ii) $y = e^{x^{x^x}}$

((5+6)+(5+6+6)+(5+5) = 38 marks)

3A. Find the Laplace transform of the following function $\left(\sqrt{t} - \frac{1}{\sqrt{t}}\right)^3$

3B. Evaluate the following integrals:

i) $\int_0^1 \frac{x^2}{\sqrt{1-x^4}}\,dx \cdot \int_0^1 \frac{1}{\sqrt{1+x^4}}\,dx$ ii) $\int_0^{\infty} te^{-t} \sin t\,dt$

3C. Solve using Laplace transform the equation $y''' + 2y'' - y' - 2y = 0$ given $y(0) = y'(0) = 0$ and $y''(0) = 6$.

(6+(6+5)+6 = 23 marks)

4A. A rectangular box open at the top is said to have volume of 32 cubic feet. Find the dimensions of the box requiring least material for its construction.

4B. The period T of a simple pendulum is given by $T = 2\pi\sqrt{\frac{1}{g}}$. If T is computed using $l = 80\ cm$ and $g = 981\ cm/sec^2$. Find approximately error in T if the true values are 80.2 cm and $981.4\ cm/sec^2$. Also find the percentage error.

(6+6 = 12 marks)

5A. Uranium disintegrates at a rate proportional to the amount present at any instant. If M_1 and M_2 grams of uranium are present at times T_1 and T_2 respectively, find the half-life of uranium.

5B. Solve the following differential equations:

i) $\frac{dy}{dx} = (4x + y + 1)^2$, given $y(0) = 1$.

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

(6+5+4 = 15 marks)

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MANIPAL UNIVERSITY

FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JUNE 2014

SUBJECT: BASIC MEDICAL SCIENCES (ANATOMY & PHYSIOLOGY)

(2011 SCHEME)

Tuesday, June 03, 2014

Time: 10:00 – 13:00 Hrs. Max. Marks: 50

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

SECTION – A: ANATOMY: 25 MARKS

1. Name the cranial nerves in order. Give the area of distribution of trigeminal nerve. (6+4 = 10 marks)

2. Write short notes on:

2A. Interior of the larynx
2B. Cardiac muscle
2C. Neuron
2D. Blood vessels
2E. White fibro cartilage

(3 marks × 5 = 15 marks)

SECTION – B: PHYSIOLOGY: 25 MARKS

3. Essay questions:

3A. Define erythropoiesis. Describe the various stages of erythropoiesis.
3B. Describe the various passive transport mechanisms that occur across cell membrane.
3C. Explain the mechanisms of inspiration and expiration.

(5 marks × 3 = 15 marks)

4. Write short answers for the following:

4A. Define blood pressure. Give the normal value
4B. Mention any two functions of liver
4C. Mention any two functions of testosterone
4D. What is myopia and how is it corrected?
4E. Mention any two functions of hypothalamus

(2 marks × 5 = 10 marks)

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MANIPAL UNIVERSITY

FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JUNE 2014

SUBJECT: PAPER III: ELECTRONICS

(2011 SCHEME)

Thursday, June 05, 2014

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

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

PART – A

1. Answer ALL the following:

1A. Write and derive the expression for resonant frequency and bandwidth in series resonance circuit.

1B. Write a note on piezoelectric materials.

1C. Draw a neat sketch and explain the working of LVDT.

1D. What are the characteristics of ideal op-amp.

1E. What are the factors that decide the selection of a transducer.

1F. A current 30A flows through two ammeters A_1 and A_2 connected in series. The voltage across the two ammeters are 0.3V and 0.6V. Find how the same current divide when they are connected in parallel.

1G. Compare different transistor configurations.

1H. Derive the expressions for power efficiency and ripple factor in half wave rectifier.

(5 marks × 8 = 40 marks)

PART – B

2. Answer the following:

2A. Explain the working of regulated voltage power supply with block diagram.

2B. Define Ohm's law. With the proper diagram explain the working of frequency counter.

2C. Draw the block diagrams of four possible feedback connections.

2D. Draw the equivalent circuit of common emitter amplifier in terms of h-parameter and obtain the expressions for voltage and current gain.

2E. Derive the expression for diffusion current and drift current in p-type semiconductor.

(8 marks × 5 = 40 marks)

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MANIPAL UNIVERSITY

FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2014

SUBJECT: PAPER III: ELECTRONICS

(COMMON FOR BOTH OLD AND NEW REGULATION)

Monday, January 06, 20143

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

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

PART – A

1. **Answer ALL questions.**

1A. Write a note on ionic and metallic bonding.

1B. Define and derive Ohm's law and mention its limitations.

1C. Explain Zener regulators along with neat circuit diagram.

1D. With proper diagram explain the theory of AC voltmeter.

1E. Explain a stable multivibrator using IC 555.

1F. With a neat diagram solve 10 to 4 encoder.

1G. Explain the working of non-inverting amplifier using an op-amp.

1H. Write a note on thermistor.

(5×8 = 40 marks)

PART – B

2. **Answer the following:**

2A. With a neat block diagram explain the functioning of function generator.

2B. Define and explain Thevenin's and Norton's theorem.

2C. With relevant sketches explain IC fabrication.

2D. What is voltage regulator? Write a note switched mode power supply.

2E. Derive an expressions for voltage and current gain using ac equivalent of transistor amplifier.

(8×5 = 40 marks)

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MANIPAL UNIVERSITY

FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JUNE 2014

SUBJECT: PAPER IV: MODERN PHYSICS

(2011 SCHEME)

Saturday, June 07, 2014

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, $m_e = 9.11 \times 10^{-31}$ kg

1A. Derive an expression for the shift in the wavelength of scattered photon in Compton Effect.

1B. Establish Schrodinger's equation for a particle in a potential well of finite height and solve it to obtain its energy levels.

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 and iii) energy of the electron in eV

(6+6+4 = 16 marks)

2A. What are mirror nuclei? Describe how the size of the nucleus can be determined using these types of nuclei.

2B. State Ehrenfest's theorem and prove that $\langle P \rangle = m\frac{d}{dt}\langle r \rangle$

2C. An electron is trapped in a one-dimensional potential well of width 0.1 nm and infinite height. Find the amount of energy required to excite the electron to its first excited state. What is the probability of finding the electron in its first excited state between x = 0.04 nm and x = 0.06 nm?

(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. Based on Fermi's theory of beta decay obtain the expression for Fermi distribution of emitted beta particles.

3C. A Gieger Muller Counter has a metal cylinder 2.5 cm in diameter along whose axis there is a stretched wire of diameter 1.25×10^{-4} cm. If the potential difference between them is 750 V then what is the electric field at the (i) Surface of the wire? (ii) Surface of the cylinder?

(6+6+4 = 16 marks)

4A. Obtain the relation between the range and depth of the potential in ground state of Deuteron.

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

4C. Calculate the Q-value for $^{19}F(p,\alpha)^{16}O$ 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. Establish the semi-empirical formula for nuclear binding energy based on the liquid drop model of the nucleus.

5B. Discuss the centre of mass system for nucleus - nucleus collision and hence obtain the relation between angles of scattering in Lab and CM systems.

5C. A ruby laser emits light of wavelength 693.4 nm. Assuming that, this light is due to transition of an electron in an infinite height potential box from the $n = 2$ state to $n = 1$ state, find the width of the box.

(6+6+4 = 16 marks)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2014

SUBJECT: PAPER IV: MODERN PHYSICS

Wednesday, January 08, 2014

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, $m_e = 9.11 \times 10^{-31}$ 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. 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.

1B. State *Ehrenfest's theorem* and prove that $\langle P \rangle = m\frac{d}{dt}\langle r \rangle$

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 and
iii) energy of the electron in eV.

(6+6+4 = 16 marks)

2A. Establish Schrodinger's equation for a particle in a potential well of *finite height* and solve it to obtain its energy levels.

2B. Describe *Hofstader's electron scattering experiment* for the measurement of nuclear charge distribution and discuss the results.

2C. Estimate the potential difference through which a proton is needed to be accelerated so that its de-Broglie wavelength becomes equal to 1Å.

(6+6+4 = 16 marks)

3A. Explain the *quantum mechanical tunnelling* process during α-decay.

3B. Using the expression for Fermi distribution for the emitted beta particle during beta decay, explain *Kurie plot* and $Ft_{1/2}$ *values*. Describe their significance.

3C. A GM tube with a cathode 5cm in diameter and a central wire of diameter 0.012cm is filled with Argon to a pressure such that the mean free path is 7.8×10^{-4}cm. Calculate the value of

the voltage that must be applied to just produce an avalanche. (The ionisation potential of Argon is 15.7volt).

(6+6+4 = 16 marks)

4A. Write a note on *non-conservation of parity in beta decay* and *internal conversion* in gamma decay.

4B. Describe the principle, construction and operation of *NaI(Tl) scintillation detector*.

4C. Calculate the energy released when 1 kg of $^{235}_{92}U$ fissions, taking the disintegration energy per event to be $Q = 208$ MeV.

(6+6+4 = 16 marks)

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

5B. Derive the *four factor formula* for fission chain reaction in a nuclear reactor.

5C. Radiation of wavelength 290 nm falls on a metal surface for which the work function is 4.05eV. What potential is needed to stop the most energetic photoelectrons?

(6+6+4 = 16 marks)

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FIRST SEMESTER M.Sc. (MEDICAL RADIATION PHYSICS) DEGREE EXAMINATION – JANUARY 2014

SUBJECT: PAPER V: FUNDAMENTALS OF COMPUTERS AND COMPUTER PROGRAMMING

Friday, January 10, 2014

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

✍ **Answer any FIVE full questions.**

1A. Explain the parts of a computer with a neat block diagram.

1B. What are the features of Network Servers?

1C. What is flash memory?

(6+5+5 = 16 marks)

2. Perform the following number system conversions:

2A. $(1011011)_2$ = (_____)$_{10}$

2B. $(3475)_{10}$ = (_____)$_8$

2C. $(12345)_8$ = (_____)$_{16}$

2D. $(A1C)_{16}$ = (_____)$_2$

(4×4 = 16 marks)

3. Write short notes and draw a neat diagram to explain the working of:

3A. Plasma Monitors

3B. Floppy disks

(8×2 = 16 marks)

4A. What are the generations of computer programming languages? Give examples.

4B. Differentiate between system software and application software.

4C. What is Spreadsheet software? Explain its features.

(7+4+5 = 16 marks)

5A. Explain the syntax of the FOR statement with an example.

5B. Draw a flow chart and write a C program to input the date of birth of a user and check if the birth date is a valid date.

(4+12 = 16 marks)

6A. Explain with a neat diagram the different layers of the OSI reference model. What is the functionality of each layer?

6B. What is data redundancy?

(12+4 = 16 marks)

7A. Explain the applications of Digital Image Processing.

7B. What is Image compression? What are the different types of Image compression?

(8+8 = 16 marks)