TECHNICAL UNIVERSITY OF KENYA

FACULTY OF APPLIED SCIENCES AND TECHNOLOGY

SCHOOL OF COMPUTING & INFORMATION TECHNOLOGY

END OF SEMESTER DECEMBER 2016 EXAMINATION SERIES
FIRST SEMESTER EXAMINATIONS 2016/2017

FIRST YEAR EXAMINATION FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY IN COMPUTER TECHNOLOGY

BACHELOR OF TECHNOLOGY IN INFORMATION TECHNOLOGY

BACHELOR OF TECHNOLOGY IN COMMUNICATION AND COMPUTER NETWORKS

ECSI 1101 /ECII 1101/ECCCI 1101: PHYSICS

Time: 2 Hours **December 2016**

Instructions to candidates:

This paper consists of FIVE Questions. You should have a scientific calculator.

Answer Question ONE [30 Marks] and any other TWO Questions [20 Marks Each].

Write your college number on the answer sheet.

This paper consists of 4 printed pages

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Question 1 (30 marks) COMPULSORY)

(a) (i) Briefly describe the scientific method of study. (1 marks)

(ii) By dimensional analysis, determine the SI units of the universal gravitational constant. (2 marks)

(b) An explorer walks 30 Km in a direction 45^0 North of East and then 18 Km straight North. How far and in what direction is he from the starting point?
(3 marks)

(c) (i) Give the name of the spatial coordinate system associated with each of the following sets of coordinates:

r,Θ,ϕ_____
r,Θ, z_____

(2 marks)

(ii) Which one of the two coordinate systems above would best describe the position
of a point on the surface of the earth? (1mark)

(d) (i) Distinguish between kinematics and dynamics. (2 marks)

(ii) Briefly describe 'free fall motion'.
(1 marks) (iii) A golfer strikes a ball on a flat lawn giving it an initial velocity of 30 m/s at an angle 40^0 with the horizontal. ($g = 9.8 m/s^2$)

I. What horizontal distance does the ball travel before striking the lawn? (2 marks)

II. What is the maximum height of the ball above the lawn?
(2 marks)

(e) (i) State Newton's second law of motion. (1 mark)

(ii) A force of 20N is applied to a crate at an angle 30^0 with the horizontal. The crate moves a distance 7m along the ground. What is the work done by the force? (2 marks)

(iii) Give an example of a non-conservative force. (1 marks)

(i) In uniform circular motion, there is acceleration but speed remains constant. explain. (1 mark)

(iv) In each of the following cases, mention the force that keeps the moving object in orbit.

I. A stone tied to a string and whirled in a horizontal circle. (1 mark)

II. A car moving round a curved bend. (1 mark)

(f) (i) Distinguish between transverse and longitudinal waves. (2 marks)

(ii) A pendulum bob of mass 'm' is oscillating on a string of length 'l' with angular displacement 'Ɵ'. Determine whether this kind of motion is simple harmonic motion (SHM). 3 marks)

(h)(i) Which property of gamma rays enables them to go through electric and magnetic fields undeflected? (1 mark)

(ii) Distinguish between isotopes and isobars. (1 mark)

SECTION B: (ANSWER ANY TWO QUESTIONS)

Question 2 (20 Marks)

(a) State the principle of conservation of linear momentum. (1 mark)

(b) Distinguish between elastic and inelastic collisions. (2 marks)

(c) What is a perfectly inelastic collision? (1 mark)

(d) (d) An 80g bullet is fired from a revolver of mass 3Kg with a velocity of 300 m/s.

Calculate the recoil velocity of the revolver. (3 marks)

(e) Define a conservative force and give an example. (2 marks)

(f) A particle moves in a circular path of radius 22 cm. It covers a distance of 20cm in 5 secs. Work
out its: (i) angular displacement Θ. (2 marks)

(ii) Angular velocity ώ. (2 marks)

(iii) Linear velocity v in SI units. (3 marks)

(iv) Periodic time T (2 marks

(g) (i) State the law of universal gravitation. (1 mark)
(ii) When is a satellite said to be in parking orbit? (1 mark)

Question 3 (20 Marks)

(a) Distinguish between vibratory and oscillatory motion. (2 marks)

(b) Sketch a displacement-time curve for two sinusoidal waves of same amplitude

that are $\frac{\pi}{2}$ radians out of phase. (2 marks)

(c) A sinusoidal motion is described as $x = A\sin\theta$ where the symbols have the usual meanings. By introducing ώ and v, derive an expression for working out the amplitude A of the wave. (4 marks)

(d) (i) What is 'damping' as applied to SHO's? (1 mark)

(ii) State what provides the damping force in the following cases.

I. mass oscillating at the end of a spring. (1 mark)

III. an oscillating pendulum. (1 mark)

IV. sketch a wave profile for a damped SHO. (1 mark)

(e) What are forced vibrations? Give an example. (2 marks)

(f) (i) Briefly describe electromagnetic waves (1 mark)

(ii) Mention any two clear differences between electromagnetic and mechanical wave (2 marks)

(g) (i) State Snell's law. (1 mark)
(ii) Mention two conditions necessary for light to travel in a straight line. (2 marks)

Question 4(20 Marks)

(a) Consider a plate of surface area A with uniformly distributed charge +Q. At a distance x on a parallel plate also of area A, let an opposite charge –Q be induced.

(i) Using Gauss's law, show that .
(7 marks)

(ii) show that the p.d between the two plates is (let top plate be zero)

$E = \frac{\sigma}{\varepsilon}$, $V = \frac{Q_x}{A\varepsilon}$ (6 marks)

(iii) Show that the capacitance of the pair of plates is

$C = \frac{A_\varepsilon}{x}$ (3marks)

(b) Two conductors X and Y are of length l and $2l$ and cross sectional area A and $\frac{A}{2}$ respectively. How do their resistances compare if they are made of the same material? (3 marks)

(c) State Faraday's law of electromagnetic induction. (1mark)

Question 5 (20 Marks)

(a) What is artificial radioactivity?

(1 mark)

(b) Distinguish between nuclear fission and fusion and give an example for each using nuclear equations. (4 marks)

(c) (i) Define half-life. (1 mark)

(ii) A given sample of radioactive carbon-14 took 7440 years to disintegrate to 6.25% of its original mass. Work out the half life of carbon-14. (3 marks)

(iii) Give one important use of carbon-14. (1 mark)

(d) Name two radiation detectors based on ion collection and another two based on optical effect. (4 marks)

(e) What are the three most important factors in radiation protection. (3 marks)

(f) 50g of a radioactive sample of half life 20 minutes disintegrated for 2 hours.

How much of the sample remained? (2 marks)

(g) Write the orbital electronic configuration for sodium (atomic number 11) (1 mark)