GARISSA UNIVERSITY COLLEGE

(A Constituent College of Moi University)

UNIVERSITY EXAMINATION 2016/2017 ACADEMIC YEAR ONE SECOND SEMESTER EXAMINATION

SUPPLEMENTARY/SPECIAL EXAMINATION

SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

COURSE CODE: PHY 122

COURSE TITLE: MODERN PHYSICS

EXAMINATION DURATION: 3 HOURS

DATE: 29/09/17 **TIME: 09.00-12.00 PM**

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

This paper consists of THREE (3) printed pages ***please turn over***

QUESTION ONE (COMPULSORY)

(a) Define the term inertial frame of reference **[1 mark]**

(b) Discuss the postulates of the special theory of relativity **[4 marks]**

(c) Define Photoelectric effect **[2 marks]**

(d) Describe a black body. **[2 marks]**

(e) Calcium has a work function of 2.7eV, what is the maximum wavelength that will cause emission from calcium. **[3 marks]**

(f) An electron which has been accelerated from rest through a p.d. of 250V. Calculate

i. The speed **[2 marks]**

ii. The de Broglie wavelength **[2 marks]**

(g) What is the meaning of nuclear binding energy and how does it relate to the mass effect **[2 marks]**

(h) A radioactive element has a decay constant $\lambda = 1.36 \times 10^{-11}\ s^{-1}$, determine how long it takes for its mass to reduce from 2g to 1g **[3 marks]**

(i) Show that the length of a 1meter stick would appear to reduce to near zero if it moves at a velocity approximately equal to that of light past a stationary observer **[4 marks]**

QUESTION TWO

(a) Discuss the aspect of Rutherford's atomic model which contradicted the electromagnetic theory. **[4 marks]**

(b) State the Bohr's postulate and discuss shortfalls of the Bohr's postulates **[6 marks]**

(c) Show how de Broglie's wave theory predicts quantization of angula momentum of electron on any orbit of radius r. **[5 marks]**

QUESTION THREE

a) (i) Define the term Compton effect and state what does it demonstrates **[3 marks]**

(ii) Calculate a shift in the wavelength of a photon scattered at an angle of 60^0 in the Compton Effect **[4 marks]**

b) (i) Light of wavelength 5.0×10^{-7}m illuminates a metal whose work function is 2.0eV.Calculate the Maximum kinetic energy in joules of the emitted electrons **[4 marks]**

(ii) Discuss two factors believed to be the cause of radioactivity of radioactive elements **[4 marks]**

QUESTION FOUR

(a) (i) Discuss the Michelson-Morley experiment and explain the implication of its results **[5 marks]**

(ii) Using the inverse Lorentz transformation derive the formula for time dilation **[5 marks]**

(b) (i) Differentiate between fission and fusion as used in radioactivity. **[2 marks]**

(ii) Part of the Uranium decay series is shown below

$$^{238}_{92}\text{U} \xrightarrow{(1)} {}^{234}_{90}\text{Th} \xrightarrow{(2)} {}^{234}_{91}\text{Pa} \xrightarrow{(3)} {}^{234}_{92}\text{U}$$

What particle is emitted at each decay? **[3 marks]**

QUESTION FIVE

(a) Discuss the Davission –Germer experiment stating clearly what its result demonstrate **[6 marks]**

(b) Describe how X-rays are produced in a modern X-ray tube, stating factors, which must be taken into consideration to generate X-rays of required quality **[5 marks]**

(c) Discuss two factors believed to be the cause of radioactivity of radioactive elements **[4 marks]**

QUESTION SIX

(a) Define the term nuclear mass defect **[1 mark]**

(b) The solar spectrum has the approximate shape of a blackbody. The peak intensity is found at a wavelength of 4700Å. Calculate the surface temperature of the sun **[3 marks]**

(c) Show that the energy of an electron is given by $E = -\frac{me^4}{8\varepsilon_o^2 n^2 h^2}$ (where n = 1,2,3…….)

[7 marks]

(d) Consider a sample with N undecayed nuclei. Show that for such a sample, the number of nuclei remaining after a time t is given as $N = N_o e^{-\lambda t}$ where the symbols have their usual meaning. **[4 marks]**