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OFFICE OF THE DEPUTY PRINCIPAL

ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2017 /2018 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

COURSE CODE: PHY 111

COURSE TITLE: BASIC PHYSICS II

DATE: 23th, APRIL, 2018 **TIME: 2.00 PM – 5.00 PM**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

THIS PAPER CONSISTS OF 6 PRINTED PAGES **PLEASE TURN OVER**

PHY 111 **BASICS PYSICS II**

STREAM: BSC (COM) **DURATION: 3 Hours**

SECTION A (24 Marks)

Question One (12 Marks)

(a)

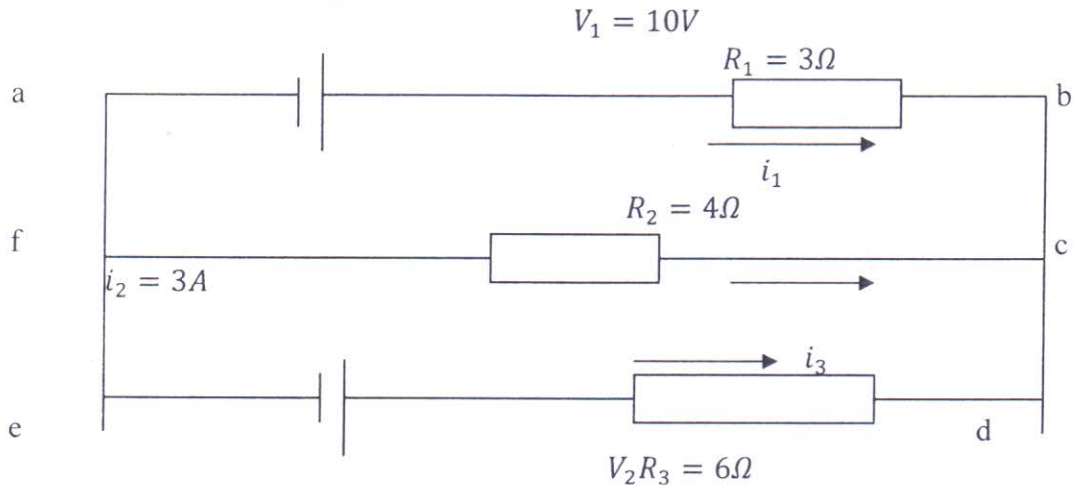
i. A torroid of length 100cm has 1500 turns and cross sectional area of 60cm^2. If it carries a current of 1.5A, compute B and H giving the appropriate units for each. (2 Marks)

ii. (ii) If the total flux density B in the torroid mentioned in (a)(i) above is measured to be$3.83 \times 10^{-3}T$, Find the magnetization M, the relative permeability μ_r and the magnetic moment, m for the whole torroid due to surface current. (5 Marks)

(b)

(i) State Kirchoff's current and voltage laws (1 Mark)

(ii) Determine the values of the currents, i_1, i_3 and V_2 in figure below, assuming that the batteries have negligible internal resistance



(4 Marks)

Question Two (12 Marks)

(a) Draw the variation of the magnetic intensity B with the applied field H for a typical magnetic material taken through a complete cycle of magnetization. Use the diagram to define,

(i) Saturation point for the material

(ii) Remanance

(iii) Coercive force of the specimen (4 Marks)

(c) With the help of a well labeled diagram, show that the current density J in a wire of cross sectional area,A and n free electrons per unit volume which are drifting with a velocity V is $J = neV$ (3 Marks)

(d) What are the majority and minority charge carriers in a p-type semiconductor? Where do the minority carriers come from? (1 Mark)

(e) Define the half life of a radioactive sample. How long does it take for 60% of a sample of radon to decay? Half life of radon is 3.8 days (4 Marks)

SECTION B (36 Marks)

Question Three (12 Marks)

(a)

(i) Show that the work done in increasing the charge in a capacitor C which is connected to a potential difference V is (3 Marks)

(ii) A 370 μF capacitor in a photoflash unit is charged to a potential difference of 330 V. How much charge and energy is stored on the capacitor (2 Marks)

(b) When an R-L-C circuit is driven in resonance, what is the impedance? (1 Mark)

(c)

(i) With the aid of clearly labeled diagrams distinguish between concave and convex lenses. (2 Marks)

(ii) A converging lens has two surfaces with radii of curvature $R_1 = 80$cm and $R_2 = 36$cm to the left of the lens for which n=1.63. Find the power of the lens. (2 Marks)

(iii) Why is that white light sources are not used in Young's double slit experiment (1Mark)

(d) Explain why n-p-n transistors are most widely used and especially so for high frequency applications as opposed to p-n-p transistors (1 Mark)

Question Four (12 Marks)

(a) A $10\mu F$ capacitor is connected into a charging circuit with a power supply of 12V and a resistor of 100Ω. Find,

(i) The time constant for the circuit

(ii) The maximum charge on the capacitor

(iii) If the charge on the capacitor at any given time t is, $Q = Q_0\left(1 - e^{\frac{-t}{RC}}\right)$, how long does it take for the capacitor to be charged to 90% of its maximum charge? (4 Marks)

(b) An L-R-C series circuit has a resistance $R = 250\Omega$, inductance $L = 0.60H$ and capacitance $C = 3.50\mu F$ is connected to a voltage source $V(t) = 150\sin(377\ \text{rad}/s)t$. Determine the,

(i) Impedance Z.

(ii) Phase angle φ.

(iii) Current in the circuit i(t).

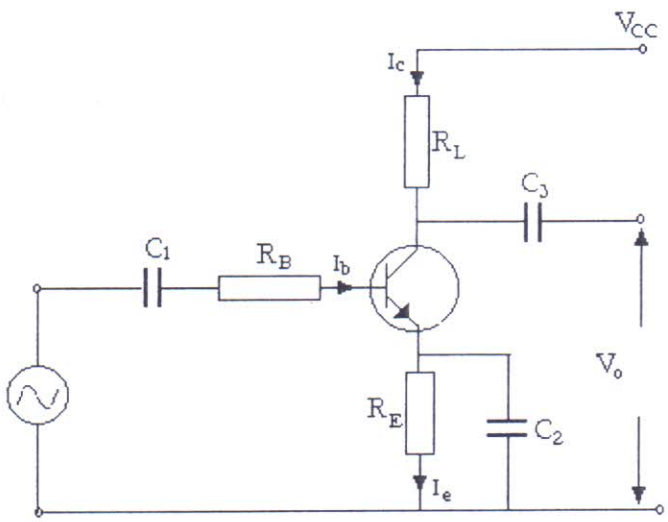
(iv) Current at t=1.24s.

(v) Potential drops $V_R(t)$, $V_L(t)$ and $V_C(t)$ (8 Marks)

Question Five (12 Marks)

(a) Distinguish between intrinsic and extrinsic conduction in semiconductors. Explain the terms donor impurity and acceptor impurity. Explain the effect of an increase in temperature on intrinsic conduction. How does this differ from the effect of an increase in temperature on a metallic conductor? (4 Marks)

(b) The diagram below shows a common emitter transistor connection. Given R_B=1MΩ, V_{BB}=30V, V_{CC}=30V, R_E=10KΩ, R_C=5KΩ and β=100. Calculate Ie, Ic, Ib, V_C, V_E and V_{CE}.



(6 Marks)

(c) Sketch the circuit diagram of a full wave rectifier and explain how it operates. Show the input and output waveforms (2 Marks)

Question Six (12 Marks)

(a)

(i) Define the focal point of a spherical mirror (1Mark)

(ii) An object is placed 20cm from a diverging lens of focal length 15cm. Calculate the image position and magnification (3 Marks)

(b) With the aid of a clearly labeled diagram, show that the magnification of an astronomical telescope at normal adjustment is $M = \frac{f_o}{f_e}$, where f_0 is the focal length of the objective lens and f_e is the focal length of the eye piece lens. (3 Marks)

(c)

(i) Using a well labeled diagram, show that the condition for minima in a single slit experiment is $a\sin\theta = m\lambda$ where a is the size of the slit, λ is the wavelength of the light used and m is the order of the spectra. (3 Marks)

(ii) A single slit has a width of $2.1 \times 10^{-6}m$ and is used to form a diffraction pattern. Find the angle that locates the second dark fringe when the wavelength of the light used is 430nm. (2 Marks)

Question Seven (12 Marks)

(a) What are *x-rays*? Sketch the apparatus used in the study of x-rays and hence mention two properties used to detect x-rays. (4 Marks)

(b) Define the Binding energy of a radionuclide.

Find the binding energy per nucleon of deuterium $^{2}_{1}H$ given that the measured mass of a deuterium nucleus is $2.0141u$ (2 Marks)

(c) Starting with the activity law of a radioisotope that $R = R_0e^{-\lambda t}$, show that the time taken by an ancient item that died many years ago is $t = \frac{1}{\lambda}\ln\left(\frac{R_0}{R}\right)$ where the symbols have their usual meanings. (2 Marks)

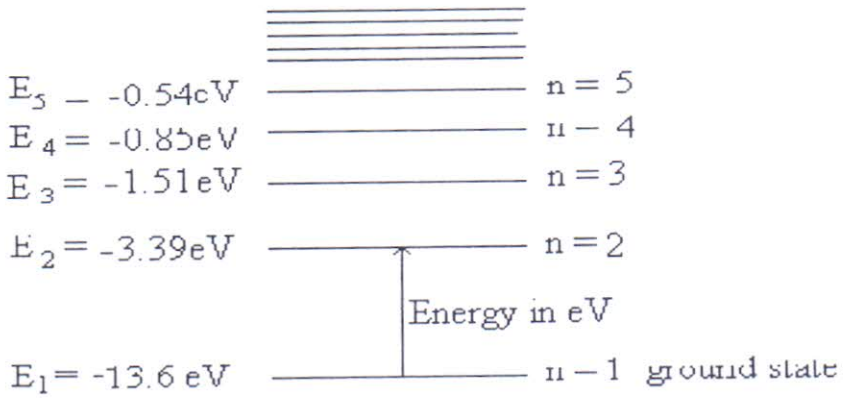
$$\frac{\ln \frac{R}{R_0}}{-\lambda t}$$

$$\ln = \frac{R - \lambda t}{R_0}$$

$$\frac{-\lambda t}{\ln} = \frac{R}{R_0} \qquad t = \ln \frac{1}{\lambda}\left(\frac{R_0}{R}\right)$$

$$-\lambda t = \frac{R}{R_0}\ln \qquad t = \frac{R}{R_0 - \lambda}\ln$$

(d) The figure below shows some of the energy levels for the hydrogen atom



(i) Find the wavelength of the lines due to electron transitions from n=2 to n=1, given that the Rydberg constant is $R = 10973731.534m^{-1}$. In which series does this spectrum lies? (2 Marks)

(ii) What is the ionization energy of the hydrogen atom? (1Mark)

(iii) Why are the energies given as negative numbers? (1 Mark)

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