CHUKA UNIVERSITY

BACHELOR OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT CODE: PHYS 113 UNIT TITLE: PHYSICS B

DATE: JAN-APRIL 2021 TIME: 2 HOURS

MAIN EXAM

Answer question one and any other two questions

QUESTION ONE (30MKS)

1) a) Define the following terms

i) Electric dipole

ii) Electric potential [2mks]

b) Two point charges q_1=2.1×10^{-8} and q_2=-4.0q_1 are fixed in place 50cm apart. Find the point along the straight line passing through the two charges at which the electric field is zero [4mks]

c) State Kirchhoff's circuital laws [2mks]

d) Three capacitors of capacitance 3 μF, 4 μF and 5 μF are connected in series. Determine the charge stored across the 4 μF capacitor if a potential of 12 V is applied across the arrangement. [4mks]

e) A solenoid has 100 turns and a length of 10 cm. It carries a current of 0.5 A. What is the magnetic field inside the solenoid? [3mks]

f) What is total internal reflection and what are the two necessary conditions for it to occur? [3mks]

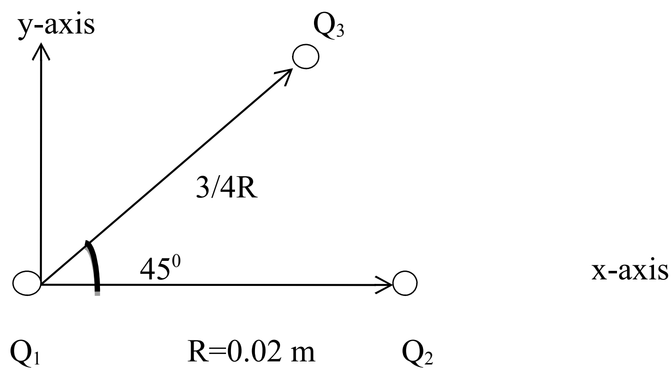
g) Briefly give the structure and working of a fibre optical cable give three of its application. [5mks]

h) Calculate the critical angle of a material of refractive index 1.42 [2mks]

i) An object is placed 15 cm in front of a convex mirror of focal length 10 cm. Describe the nature of the image formed [5mks]

QUESTION TWO [20MKS]

a) Figure below shows three charged particles fixed in place, the charges are $Q_1=1.6\times10^{-19}$ C, $Q_2=3.2\times10^{-19}$ C and $Q_3= -3.2\times10^{-19}$ C



What is the net electrostatic force F1.net on particle 1 due to 2 and 3 [8mks]

b) A capacitor C_1 is charged to a p.d Vo, the battery is then removed and the capacitor connected to an uncharged capacitor C_2.

i) What is the final p.d V a cross the combination [4mks]

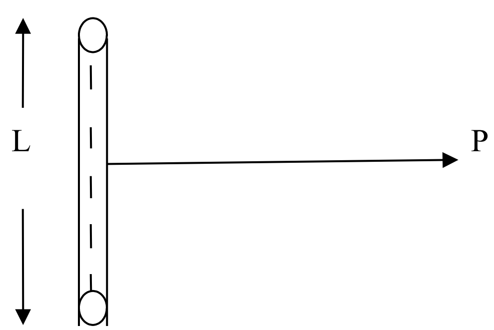
ii) What is the stored energy before and after the switch is connected [3mks]

c) Using Biot-Savart law, show that the magnetic field at a point P a long a perpendicular bisector of a current carrying straight conductor. [5mks]

$$B=\frac{u_0 i}{2\pi r}$$

QUESTION THREE [20MKS]

a) The figure below show a uniform line of charge [9mks]



Show that the electric field at a point P from the uniform line of charge is;

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{\lambda L}{x\sqrt{x^2 + \left(\frac{L}{2}\right)^2}}$$

b) Assuming that x >> L, obtain the equation for the electric field in question a) above [3mks]

c) Suppose a parallel plate capacitor has plate that are 2.0 cm by 3.0 cm which are separated by 1.0 mm. The maximum electric field in air, called the dielectric strength of air, is 3.0×10^6 V/m

i) What is the maximum charge that can be placed on this capacitor? [4mks]

ii) Suppose paper with a dielectric constant of k=3.7 and a dielectric strength of 16×10^6 V/m is placed between the plates. How much charge can it hold now

[4mks]

QUESTION FOUR [20MKS]

a) Show that the image formed by the mirror is as far behind the mirror as the object is in front [7mks]

b) Starting from Fermat's principle, prove the law of reflection [13mks]

QUESTION FIVE [20MKS]

a) A ray of light travelling through a liquid of absolute refractive index 1.4 is incident on the plane surface of a Perspex block at an angle of 55^o

i) Calculate the angle of refraction in the Perspex if it has an absolute refractive index 1.5 [4mks]

ii) Determine the critical angle for light passing from flint glass (n_1=1.65) to water (n_2=1.33) [3mks]

b) An object is placed 12 cm to the left of a diverging lens of focal length 6 cm, a converging lens of focal length 12 cm is placed a distance d to the right of the diverging lens. Find the distance d that places the final image at infinity [6mks]

c) An object placed 10 cm from a concave spherical mirror produces a real image 8 cm from the mirror. If the object is moved to a new position 20 cm from mirror, what is the position of the image? Is the final image real or virtual? [7mks]

CHUKA UNIVERSITY

BACHELOR OF SCIENCE IN BMED, FOOD SCIENCE AND TECHNOLOGY, HORTICULTURE AND ENVIROMENTAL SCIENCE

UNIT CODE: PHYS 111 UNIT TITLE: GENERAL PHYSICS

DATE: JAN-APRIL 2021 TIME: 2 HOURS

MAIN EXAM

Answer question one and any other two questions

QUESTION ONE (30MKS)

a) Explain why it is advisable to connect bulbs in parallel and not in series [2mks]

b) Discuss briefly the three modes of heat transfer [6mks]

c) Explain why heat transfer is faster in conductors than in non-conductors [2mks]

d) Give the conditions for total internal reflection [2mks]

e) A ray of light travelling through a liquid of absolute refractive index 1.38 is incident on the plane surface of a glass block at an angle 30^0. Calculate the angle of refraction in the glass if it has an absolute refractive index 1.5 [5mks]

f) What is specific heat capacity? [2mks]

g) Explain why it feels cold when methylated spirit is poured at the back of your hand [4mks]

h) State Newton's first law of motion [1mks]

i) A charge of quantity $9*10^{-6}$ C flows through a conductor in 20 seconds, calculate the amount of current in the conductor [2mks]

j) An object is placed 10 cm in front of a concave mirror of focal length 15 cm, find the position and nature of the image formed. [4mks]

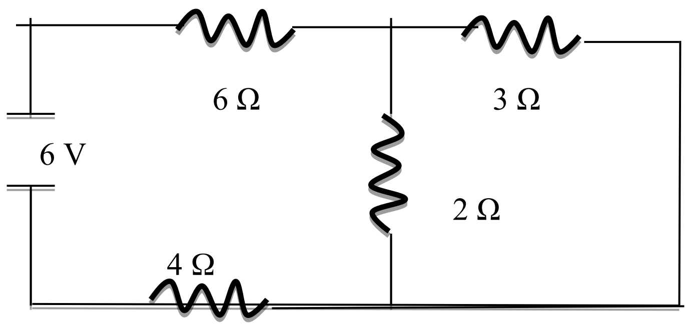
QUESTION TWO (20MKS)

a) State Kirchoff's circuital laws [2mks]

b) Four resistors are arranged as shown below, find;

i) The total resistance [3mks]

ii) The current flowing through each resistor [7mks]



c) A resistor of unknown resistance and a 35 Ω resistor in parallel are connected a cross a 120 V e.m.f in such a way that 11 A current flows. What is the value of the unknown resistor [5mks]

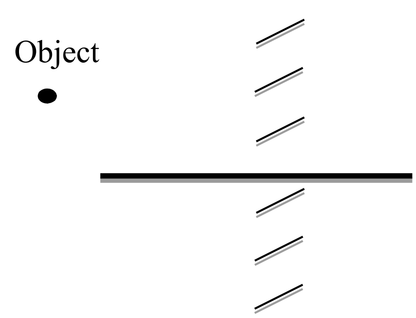
d) Two identical light bulbs are connected to a battery. Will the light bulbs be brighter if they are connected in series or in parallel? Explain [3mks]

QUESTION THREE (20MKS)

a) State any three properties of light [3mks]

b) Give the characteristics of images formed by a plane mirror [4mks]

c) A point object is placed in front of a plane mirror as shown below, show using ray diagrams the position of the image [3mks]



d) By applying mirror formula, find the position of an object that gives an image located 15 cm in front of a concave mirror of focal length 10 cm [5mks]

e) If the refractive indices from air to glass and from air to water are 1.5 and 1.33 respectively, calculate the critical angle for water glass interface [5mks]

QUESTION FOUR (20MKS)

a) Explain briefly why ventilation spaces are located close to the roof [4mks]

b) Define specific latent heat of vaporization [2mks]

c) A 4 kg of ice at a temperature of -10 C is converted to water at a temperature of 75 C. Calculate the quantity of heat used. Take specific heat capacity of ice 2100 J/kg/K, specific latent heat of fusion of ice $1.7*10^5$ J/kg, specific heat capacity of water 4200 J/kg/K [7mks]

d) A metal block of mass 5 kg at a temperature 50 C and specific heat capacity of 240 J/kg/K is plunged into water of mass 12 kg at a temperature of 10 C in a copper calorimeter of mass 2 kg. Calculate the final temperature of the system. Given the specific heat capacity of water and copper as 4200 J/kg/K and 3500 J/kg/K respectively. [7mks]

QUESTION FIVE (20MKS)

a) State the law of conservation of momentum [2mks]

b) Trolley A of mass 2 kg initially travelling at 15 m/s collides with trolley B which is traveling at 10 m/s in the opposite direction. After collision trolley B reaches a velocity 6 m/s in the initial direction of trolley A. While trolley A eventually rebounds at 2 m/s. Calculate the mass of trolley B [5mks]

c) A bullet is projected at a horizontal velocity of 120 m/s from a building 50 m high. Calculate;

i) Time it takes to hit the ground [4mks]

ii) The horizontal distance from the foot of the building to where it hits the ground

[4mks]

d) A bus accelerates at 3 m/s^2 in 20 minutes from rest then maintains the velocity attained for the next 30 minutes. It then decelerates to rest at 5 m/s^2. Calculate the total distance covered by the track [5mks]

CHUKA UNIVERSITY

BACHELOR OF SCIENCE IN PHYSICS

UNIT CODE: PHYS 494 UNIT TITLE: APPLIED GEOPHYSICS

DATE: JAN – APRIL 2021 TIME: 2 HOURS

MAIN EXAM

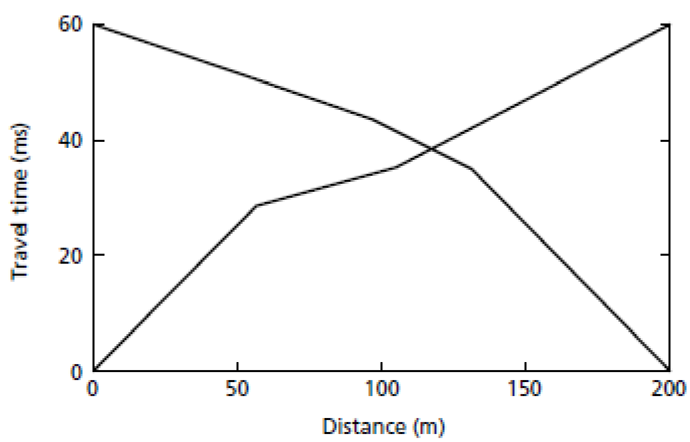
Answer question one and any other three questions

QUESTION ONE (30 MKS)

a) List and briefly discuss two main properties used to identify ores in geophysical explorations

[4mks]

b) What subsurface structure is responsible for the travel time shown below for both forward and reverse traverse? Explain



[5mks]

c) What is forward modelling, explain the forward modelling procedure [5mks]

d) Compression ray travels with a velocity of 2.1×10^3 m/s in a rock material of density 267 kg/m^3 and at a velocity 1.6×10^3 in a rock layer of density 295 kg/m^3, calculate its reflection coefficient [4mks]

e) Explain the meaning of a hidden layer in seismic refraction [3mks]

f) Describe how remanent magnetization is acquired by rocks [5mks]

g) Describe two main approaches in the interpretation of seismic sections [4mks]

QUESTION TWO (20 MKS)

a) Describe how to minimize the ambiguity in geophysical data interpretation [4mks]

b) List and discuss the principle modes of electrical conduction in rocks [6mks]

c) Archie's equation given below is important in conduction of electrical current through porous media

$$\rho = a \varnothing^{-m} S^{-n} \rho_w$$

i) List and describe all the variables in the equation [5mks]

ii) Explain how this equation is used in practice [5mks]

QUESTION THREE (20 MKS)

a) What is seismic reflection survey? [2mks]

b) State the limitations of seismic reflection method in petroleum exploration [3mks]

c) To find the depth to bed rock in a damp site survey travelling times are measured from the shot point to 12 geophones laid out at 15 m interval in a straight line through the shot point. The offset x range from 15 m to 180 m, determine the depth of overburden from the data.

X (m)	T (ms)	X (m)	T (ms)
15	19	120	68
30	29	135	72
45	39	150	76
60	50	165	78
75	59	180	83
90	62		
105	65		

[15mks
]

QUESTION FOUR (20 MKS)

a) Werner and Schlumbuger electrode configurations are the main electrode arrangements used in resistivity investigations.
Sketch the four electrode configurations in electrical resistivity survey for these modes of survey pointing out the merits of each of them and the demerits of one over the other in field studies [7mks]

b) Write down or derive the fundamental equations for each electrode arrangement

[5mks]

c) Using any one electrode arrangement discuss how vertical electrical surveying can be conducted [5mks]

d) Sketch possible profile for a three layer geological system would appear when the layers are of same thickness but

-most resistive layers at the top and bottom [3mks]

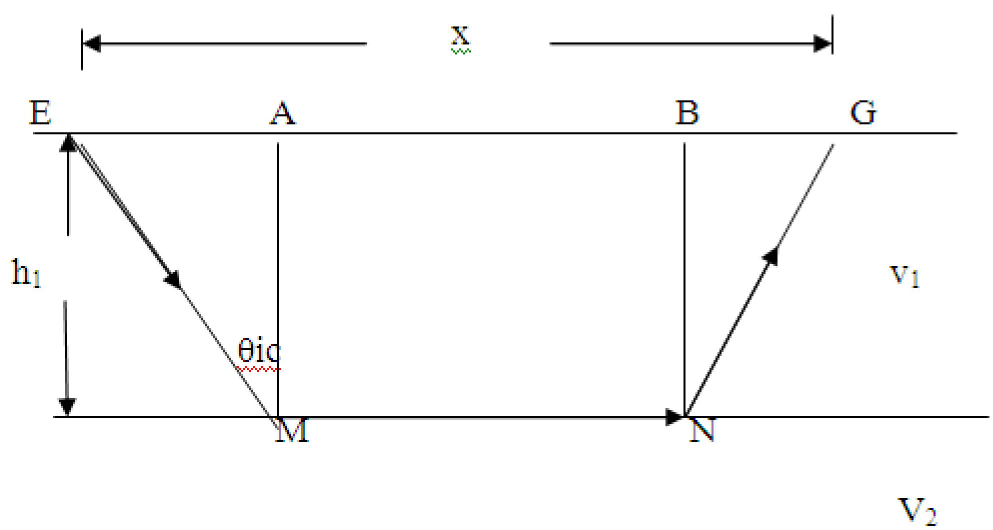
QUESTION FIVE (20 MKS)

a) Explain three ways in which the generated p-waves move in seismic refraction [3mks]

b) Show that the velocity of propagation of body waves is given by [7mks]

$$V_p = \sqrt{\frac{E(1-\mu)}{\rho(1-2\mu)(1+\mu)}}$$

b) The figure below shows an arrangement for seismic refraction for a two layer case with horizontal interface.



Show that the total travel time is given by [10mks]

$$t = \frac{2h_1[1 - \left(\frac{v_1^2}{v_2^2}\right)^{1/2}]}{v_1} + \frac{x}{v_2}$$

CHUKA UNIVERSITY

SCHOOL OF SCIENCE, ENGINEERING AND TECHNOLOGY

UNIT CODE: PHYS 342 UNIT TITLE: ELECTRICITY AND MAGNETISM II

DATE: APRIL 2021 MAIN EXAM TIME: 2 HOURS

Answer question one and any other two questions

QUESTION ONE (30MKS)

1 a) State any three applications of Gauss's law [3mks]

b) Derive an expression for electric potential V of a point charge Q [4mks]

c) Calculate the potential at a point 0.05 m inside a charged sphere of radius 0.1 m and volume charge density $2.4 \times 10^{-7} C/m^3$ [5mks]

d) Distinguish between a conductor and a dielectric [2mks]

e) Derive an expression for the work done in changing the orientation of a dipole in electric field E from 90^0 to θ^O [4mks]

f) Derive Gauss's law in the form

$$\oint_s E.da = ¿\frac{Q}{\varepsilon o}¿$$

[5mks]

g) Write down Maxwell's equations of electromagnetism in their general differential form in a vacuum [4mks]

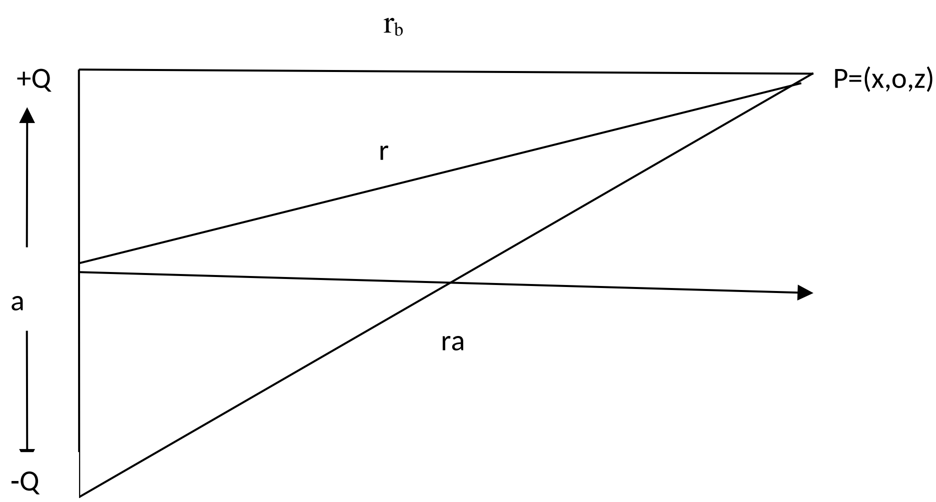
h) Explain the reason as to why charges only reside on the surface of a conductor

[3mks]

QUESTION TWO (20MKS)

2a) Show that potential due to the dipoles at a point P is given by $V_p = \frac{Qa\cos\varphi}{4\pi\epsilon\pi r2}$

[7mks]



b) From the equation for potential due to a dipole at point P, show that the electric field component in the Z- direction is given by

$E_z = \frac{P}{4\pi\varepsilon o}\left(\frac{3\cos^2\theta - 1}{r3}\right.$¿ [10mks]

b) Explain any three types of filters [3mks]

QUESTION THREE (20MKS)

3a) Laplace equation in Cartesian rectangular coordinates is

$$\frac{\sigma 2v}{\sigma x2} + \frac{\sigma 2v}{\sigma y2} + \frac{\sigma 2v}{\sigma z2} = 0$$

Assuming that the solution of this equation is a product of three functions which are separately functions of x, y and z. Show the most general form of this solution

[9mks]

b) Derive an expression for electric field **E** at a point P outside a sphere of radius R and uniform volume change density ρ [7mks]

c) Calculate the electric field at a point 0.001 m from the surface of a charged sphere of radius 0.05 m and volume charge density 4×10^{-7} C/m^3 [4mks]

QUESTION FOUR (20MKS)

4a) Staring from Gauss's law in a vacuum derive an expression for the Gauss's law in dielectric [6mks]

b) Show that the volume change density is given by

$\rho_b = -\nabla . P$ [6mks]

c) Derive the equation of continuity [8mks]

QUESTION FIVE (20 MKS)

5. a) Starting from ampere's law, derive Maxwell's electromagnetic equation

$\nabla \times B = \mu_0 J$ [8mks]

b) For a series arrangement of R, L and C circuit and given that R=3x10^5 Ω, L= 10^{-3} H and C= 60PF. Calculate:

- **i.** The total current in each arm when a voltage of 20 V r.m.s at a frequency of 0.1 MHZ is applied [5mks]
- **ii.** The phase of the total current drawn from the generator. [5mks]

c) Define polarization [2mks]

CHUKA UNIVERSITY

SCHOOL OF SCIENCE, ENGINEERING AND TECHNOLOGY

UNIT CODE: PHYS 811 UNIT TITLE: MATHEMATICAL PHYSICS

DATE: APRIL 2021 MAIN EXAM TIME: 3 HOURS

Answer question one (Compulsory) and any other three questions

QUESTION ONE (15MKS)

1) a) Use Cauchy-Riemann conditions to show that $f(z) = z^2$ is analytic in the entire z-plane

[3mks]

b) Show that the following four matrices form a group under matrix multiplication [4mks]

$$E = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}, B = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}, C = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

c) Prove the following recurrence relation for Bessel function

$$J_n'(x) = \frac{-n}{x} J_n(x) + J_{n-1}(x)$$

Where the prime denotes the differentiation with respect to x [4mks]

Given: $J_n(x) = \sum_{r=0}^{\infty} (-1)^r \left(\frac{x}{2}\right)^{n+2r} \frac{1}{r!\sqrt{(n+r+1)}}$

e) Find $\frac{\frac{dy}{dx} \wedge d^2 y}{dx^2}$ for $y = e^{-x^2}$ at the point x=0.05 from the data of the table given below

[4mks]

X	$y=e^{-x^2}$	Δ	Δ^2	Δ^3	Δ^4
0	1.00000				
0.05	0.99750	-250			
0.10	0.99005	-745	-495		
0.15	0.97775	-1230	-485	+10	
0.20	0.96079	-1696	-466	+19	+9
0.25	0.93941	-2138	-442	+24	+5
0.30	0.91393	-2548	-410	+32	+8

QUESTION TWO (15MKS)

2 a) State and prove the residue theorem [5mks]

b) Evaluate the integral

$$\int_0^{\infty} \frac{\sin x}{x} dx$$

using the residual theorem [10mks]

QUESTION THREE (15MKS)

3 a) Construct the Green's function for the problem stated mathematically as

$$\frac{d^2 y}{d x^2} - k^2 y = f(x)$$

where f(x) is a known function and y satisfies the boundary conditions $y=(\pm\infty)$ [7mks]

b) Define the shifting property of the Laplace transform and use it to find the Laplace transform of $e^{-x}\cos x$ [4mks]

c) Obtain Rodrigues' formula for the Legendre polynomials [4mks]

QUESTION FOUR (15MKS)

4 a) Evaluate the integral

$$\int_{-\infty}^{\infty} \frac{cosx}{(x^2+a^2)(x^2+b^2)} dx$$

Using the residual theorem [7mks]

b) Define isomorphism and show that the group $(i, -1, -i, 1)$ is isomorphic to the cyclic group $(A, A^2, A^3, A^4 = E)$ [3mks]

c) Using the table given below, evaluate the integral

$$\int_0^{1.0} \frac{x^3}{e^x - 1} dx$$

By using Simpson's one- third rule [5mks]

X	$f(x) = \frac{x^3}{e^x - 1} dx$
0	0
0.25	0.055013
0.50	0.192687
0.75	0.377686
1.00	0.581977

QUESTION FIVE (15MKS)

5 a) A sphere of radius *a* is centred at O. It is cut into two equal halves by the x-y plane. The upper part is maintained at potential $+V_o$ and the lower part at potential $-V_o$. Calculate the potential at a point inside the sphere in the following steps:

i) Write the Laplace's equation satisfied by the potential in spherical polar coordinates and make use of the method of separation of variables to separate it into the $\varphi-, \theta-, \wedge r-¿$ equations.

[4mks]

ii) Solve the $\varphi-, \theta-, \wedge r-¿$ equations. [5mks]

iii) Make use of the boundary conditions to find the potential. [6mks]

COURSE OUTLINE

PHYS 113: PHYSICS B

Course purpose

This course is intended to introduce learners to curved reflecting surfaces, basic electrostatics, electricity and magnetism.

Expected learning outcomes

By the end of this course, the learner should be able to:

Describe diffraction experiment and maxwell's electromagnetic equations.

State the laws electrostatics, magnetisms and Faradays' law of electromagnetic induction.

Calculate magnetic force, power in AC bridges and coulomb forces.

Explain lens LRC circuits and calculate their performance parameters.

Course content

Fermat's principle. Plane surfaces and prisms. Spherical surfaces. Lenses. Spherical mirrors. Lens aberration. Theory of interference. Fresnel and Franhouffer diffraction. Diffraction at straight edge and at a number of parallel slits. Fresnel's explanation of optical activity. Polarimeters. Electrostatics: electric charge, coulomb's law, electric field, lines of electric force and electric flux. Gauss's law, electric potential and electric potential energy. Capacitors and capacitance, energy storage in capacitors, effect of dielectrics on capacitance. Voltage measurement, potentiometer, Magnetic field, magnetic flux, force on moving charge in a magnetic field, torque on a current loop, magnetic dipole. Magnetic induction: Faraday's laws of magnetic induction, self and mutual induction. Hysteresis. Energy in magnetic fields. Solutions to Laplace's and Poisson's equations. Maxwell's electromagnetic equations. Electromagnetic radiation. AC in resistors, capacitors and inductors. Series and parallel LCR circuits. Resonance. Power in AC circuits. AC bridges, impedance and admittance. Filters.

Teaching Methodology
Lecture, Discussion and working out problems sessions. (45 hours per semester).

Teaching materials
Laboratory and workshop equipment, Text books.

Course assessment
Coursework 30%; FinalExaminations 70%, Total 100%

CHUKA UNIVERSITY

SCHOOL OF SCIENCES, ENGINEERING AND TECHNOLOGY

COURSE OUTLINE: PHYS 342-ELECTRICITY AND MAGNETISM II

A. COURSE DESCRIPTION

This is a course for physical science students on the phenomena of electromagnetism. The topics include electric charges and fields, electric potential, electric waves, dielectrics, poisons and Laplace equations, ac theory and transformers.

B. PURPOSE OF THE COURSE:

The purpose of this course is to enable the student to gain knowledge of the properties of electromagnetic fields using vector calculus, displacement current, Maxwell's equations, and plane electromagnetic waves with applications

C. COURSE OBJECTIVES:

Study the properties of electromagnetic fields using vector calculus, displacement current, Maxwell's equations, and plane electromagnetic waves with applications

D. COURSE CONTENT TOPICS

WEEK 1 (4HOURS) – Electric field, electric field intensity, potential due to a dipole

WEEK 2 (4HOURS)- Gauss's laws, Spherical charge distribution

WEEK 3 (4HOURS) – conductors, dielectrics, electric polarization
WEEK 4 (4HOURS) –Gauss's laws in dielectric, electric displacement, electric susceptibility
WEEK 5 (4HOURS) –Relationship between the free and bound charge densities
WEEK 6 (4HOURS) – Boundary conditions
WEEK 7(4HOURS) –polarization current density
- Poisson's and Laplace's equations

WEEK 8 (4HOURS) –Maxwell's Equations – Bound Current density, Magnetic Induction, Faradays law for time dependent B
WEEK 9 (4HOURS) – Electromagnetic waves
WEEK 10 (4HOURS) – Alternative current theory
WEEK 11(4HOURS) –Parallel Resonance, A.C in resistors, A.C in Capacitors, Complex Impendence

WEEK 12(4HOURS) – Transformers, Transmission lines

WEEK 13(4HOURS) –Filters and Delay lines

C: COURSE ASSESSMENT

Shall be by way of two CATS marked out of 30%

Final Examination marked out of 70%

D: MODE OF DELIVERY

- Lectures, presentation, discussion, take home assignment s

E: COURSE REQUEMENT

Registration with the lecturer

Class attended and participation - must attend 75% of lectures to qualify for exam.

REFERENCES

1. Electricity and magnetism by Duffin W.J
2. Electromagnetic fields by Wangsness R.K

3. Electromagnetic fields and waves by Lorrain P. and Carson D.R
4. The Analysis of Linear Circuits by Charles M.

CHUKA UNIVERSITY
SCHOOL OF SCIENCES, ENGINEERING AND TECHNOLOGY
COURSE OUTLINE: PHYS 494-APPLIED GEOPHYSICS

Main objective
To enable the student to acquire skills on earth properties, measurement and reduction techniques of earth data

Learning outcomes
By the end of the course the student should be able to;

- Explain gravitational, magnetic, seismic and electrical properties of the earth
- Describe the data measurement techniques for determining properties of the earth
- Discuss the data reduction and geological interpretation for earth structure, minerals and groundwater.

Course description

Gravitational, magnetic, seismic and electrical properties of the earth. Measurements, data reduction and geological interpretation for earth structure, minerals and groundwater.

Major topics

Gravitational properties of the earth. Magnetic properties of the earth. Seismic properties of the earth. Electrical properties of the earth. Measurements, data reduction and geological interpretation for earth structure. Measurements, data reduction and geological interpretation for earth structure minerals. Measurements, data reduction and geological interpretation for earth structure groundwater.

COURSE CONTENT TOPICS

WEEK 1 (4HOURS) – Gravitational properties of the earth
WEEK 2 (4HOURS)- Magnetic properties of the earth
WEEK 3 (4HOURS) – Seismic properties of the earth
WEEK 4 (4HOURS) – Electrical properties of the earth
WEEK 5 (4HOURS) – Measurements, data reduction and geological interpretation for earth structure
WEEK 6 (4HOURS) – Measurements, data reduction and geological interpretation for earth structure

WEEK 7(4HOURS) – Measurements, data reduction and geological interpretation for earth structure minerals
WEEK 8 (4HOURS)– Measurements, data reduction and geological interpretation for earth structure minerals
WEEK 9 (4HOURS) – Measurements, data reduction and geological interpretation for earth structure groundwater
WEEK 10 (4HOURS) Measurements, data reduction and geological interpretation for earth structure groundwater
WEEK 11(4HOURS) –Measurements, data reduction and geological interpretation for earth structure groundwater
WEEK 12(4HOURS) –Exam

Teaching methods

Lectures, Tutorials, Laboratory experiments, Demonstrations and illustrations, Field trip

Course references

Gadallah, M. and R. Fisher, R. (2009). Exploration Geophysics: Springer BookArchives

Further reading

Kaufman, A. R. and Kleinberg, R. (2008).Volume 42: Principles of the Magnetic Methods in Geophysics, 1st Edition
M Zhdanov (2009).Volume 43: Geophysical Electromagnetic Theory and Methods, 1st Edition
Reinhard, K. (Ed.) (2009). Groundwater Geophysics. 2nd ed.: A Tool for Hydrogeology
Telford, W.M. Geldart, L.P. and Sheriff, R.E, (1990). Applied Geophysics, 2nd edition

Evaluation
The course will evaluated as follows

C.A.T(s)	30%
END OF SEMESTER EXAMS	70%
TOTAL	100%
PASS MARK	40%

PHYS 811: MATHEMATICAL PHYSICS

Course Purpose

To understand and apply those mathematical techniques that are used in physics.

Expected Learning Outcomes

By the end of the course the student should be able to:

Define and apply matrices.

Solve differential equations

Solve and apply Fourier, Laplace and special functions.

State and apply the principles of group theory.

Course Content

Survey of vector analysis and coordinate systems, matrices (orthogonal matrices, oblique coordinates. Hermifian matrices, unitary matrices, diagonalization of matrices), tensoranalysis. Complex variables, second order differential equations, functions (Gamma function. Bessel functions. Legendre functions. Hermite functions, Laguerrefunctions. Hypergeometric functions. Chepvshev Polynomials) Fourier series, Fouriertransformation. Laplace transformation. Green function in one, two and three dimensions, calculus of variations. Introduction to group theory. Discrete groups, continuous groups, generators, homogeneous, Lorentz groups, continuous groups, generators, homogeneous. Lorentz groups.

Teaching Methodology

Lectures, Laboratory experiments, group discussions, Demonstrations and illustrations

Course Assessment

CATs 40%, Examination 60% , Total 100%

References

Beatty, Millard F. (2006). *Principles of engineering mechanics Volume 2 of Principles of Engineering Mechanics: Dynamics-The Analysis of Motion.* Springer. p. 24. ISBN 0-387-23704-6.

McQuarrie, Donald A. (2003). *Mathematical Methods for Scientists and Engineers*, University Science Books. ISBN 978-1-891389-24-5

Riley K F *et al* (2010). *Mathematical methods for physics and engineering.* Cambridge university press. ISBN-13 978-0-521-13987-8

Thijssen, Joseph (2007). *Computational Physics*. Cambridge University Press. ISBN 0521833469.

Thornton, Marion (2004). *Classical dynamics of particles and systems* (5th ed.). Brooks/Cole. p. 53. ISBN 0-534-40896-6.

PHYS832: QUANTUM MECHANICS

Purpose

To derive and apply the fundamentals of quantum mechanics.

Learning outcomes

i. To solve the Schrödinger equation for single and many particle system.
ii. To apply various approximation schemes.
iii. To derive and apply the principles of relativistic theory.
iv. To derive and apply the principles of perturbation and second quantization.

Course description

Time dependent Schrödinger equation and its applications. Time - dependent

Schrödinger equation and its application to scattering problems. Operator algebracommutation relations; Dirac notation, representations in the state space. Centralpotential and phase-shift method. Angular momentum and spin. The Wigneer-Eckarttheorem. Annihilation and creation operators. The occupational numberrepresentation. Simple many - particle system and elements of second-quantizationtheory. Perturbation theory. The Brillouin-Wigner series. The Heisenberg andinteraction representation. Introduction **to** relativistic theory - the Klein-Gordon andDirac equations, **and** properties of simple relativistic systems.

Teaching methods
Lectures, Laboratory experiments, group discussions, Demonstrations and illustrations
Evaluation;

CAT	40%
Examination	60%
Total	100%

Course references

1. Eisberg, Robert; Resnick, Robert (1985). *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles (2nd ed.)*. Wiley. ISBN 0-471-87373-X.
2. Merzbacher, Eugen (1998). *Quantum Mechanics*. Wiley, John & Sons, Inc. ISBN 0-471-88702-1.
3. Steven, W. (2012). Lectures on Quantum Mechanics
4. Shankar, R. (1994) Principles of Quantum Mechanics, 2nd Edition
5. Bernstein, Jeremy (2009). *Quantum Leaps*. Cambridge, Massachusetts: Belknap Press of Harvard University Press. ISBN 978-0-674-03541-6.
6. Bohm, David (1989). *Quantum Theory*. Dover Publications. ISBN 0-486-65969-0.
7. Sakurai, J. J. (1994). *Modern Quantum Mechanics*. Addison Wesley. ISBN 0-201-53929-2.
8. Shankar, R. (1994). *Principles of Quantum Mechanics*. Springer. ISBN 0-306-44790-8.
9. Stone, A. Douglas (2013). *Einstein and the Quantum*. Princeton University Press. ISBN 978-0-691-13968-5.

PHYS 932: Quantum Physics
Purpose
To derive and apply the fundamentals of quantum mechanics.

Learning Outcomes
By the end of the course, the learner should be able to:
- solve the Schrödinger equation for single and many particle system.
- apply various approximation schemes.
- derive and apply the principles of relativistic theory.
- derive and apply the principles of perturbation theory and second quantization.

Course Content

Revisit of Basic postulates of quantum mechanics, operators, eigen values, parity, potential wells, harmonic oscillator, time dependent and time independent Schrödinger equation, matrix formulation and the time independent perturbation theory. Time dependent perturbation theory, exchange symmetry, Dirac equation, second quantization and scattering theory. Fields, radiation, Klein-Gordon equation, relativistic quantum scattering, photon propagator

Teaching Methodology
Lectures, Laboratory experiments, group discussions, Demonstrations and illustrations, seminar presentations of latest publications.

Evaluation;

CATs and Assessments	40%
Examination	60%
Total	100%

Course references

Eisberg, Robert; Resnick, Robert (1985). *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles (2nd ed.)*. Wiley. ISBN 0-471-87373-X.
Merzbacher, Eugen (1998). *Quantum Mechanics*. Wiley, John & Sons, Inc. ISBN 0-471-88702-1.
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