NATIONAL BOARD FOR TECHNCIAL EDUCATION
KADUNA

HIGHER NATIONAL DIPLOMA

IN

PHYSICS WITH ELECTRONICS

CURRICULUM AND COURSE SPECIFICATIONS

2005

PLOT 'B' BIDA ROAD, P.M.B. 2239, KADUNA-NIGERIA

HIGHER NATIONAL DIPLOMA SCIENCE LABORATORY TECHNOLOGY (PHYSICS WITH ELECTRONICS

i. AIMS AND OBJECTIVES:- This course is designed to procedure Technologists with good knowledge of Physics and electronics and capable of applying laboratory Techniques in scientific work.

ii. LEVEL:- HND I AND HND II

In exceptional cases, ND diplomates with a pass (CGPA of 2.00-2.49) in the ND examination that had two or more years of cognate experience in the specific field may be considered for admission into the HND programme

2.0 CURRICULUM

The curriculum of all ND and HND programme consists of four main components**.**

iii. ENTRY REQUIREMENT:- In addition to National Diploma requirement, the candidate for Higher National Diploma in physics with electronics must possess at least a lower credit pass in National Diploma in Science laboratory technology and a minimum of twelve (12) months of supervised industrial experience.

I) General Studies/Education
II) Foundation courses
III) Professional courses
IV) Supervised Industrial work experience scheme (SIWES)

The General Education components shall include courses in.

ART AND HUMANITIES:- English languages, communication, History. These are compulsory. MATHEMATICS AND SCIENCE: (for non science based programme)

SOCIAL STUDIES: Citizenship (the Nigerian constitution) Political Science sociology, philosophy, Geography, Entrepreneurship, Philosophy of science and sociology are compulsory.

PHYSICAL AND HEALTH EDUCATION (One semester credit only).

The General Education component shall account for not more than 10% of total contact hours for the programme.

FOUNDATION COURSES include courses in Economics, Mathematics, Pure sciences, Technical Drawing, Descriptive Geometry, Biostatistics, Computer applications and introductory computer system.

The number of hours will vary with the program and may account for about 15-20% of the total contact hours.

PROFESSIONAL COURSES are courses which give the student the theory and practical skills he needs to practice his field of calling at the technician/ technologist level. These may account for between 60-70% of the contact hours depending on the programme.

3.0 STRUCTURE OF THE PROGRAMME: The Higher National Diploma Programme is structured to last for two years (four semesters) all of which shall be taken.

4.0 ACCREDITATION;

Each programme offered either at the ND or HND level shall be accredited by the NBTE before the diplomates can be awarded either of the two diploma certificates. Details about the process of accrediting a programme for the award of the ND and HND are available from the Executive Secretary, National Board for Technical Education Plot B, Bida Road PMB 2239, Kaduna Nigeria.

5.0 CONDITIONS FOR THE AWARD OF THE ND/HND

Institutions offering accredited programmes will award the National Diploma/Higher National diploma candidates who successfully completed the programme after passing prescribe course work, examinations, diploma project and the students industrial work experience scheme. Such candidates should have completed a minimum of between 72 and 80 semester credit units depending on the programme. Diploma shall be classified as follows:

Distinction- GPA of 3.50 and above Upper Credit GPA of 3.00 and 3.49
Lower credit GPA of 2.50 – 2.99
Pass – GPA of 2.00 – 2.49
Fail – GPA of below 2.00.

6.0 GUIDANCE NOTES FOR TEACHERS TEACHING THE PROGRAMME

The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy an Education which stress the need to introduce the semester credit units which will enable a student who so wish to transfer the units already completed in an institution of similar standard from which he is transferring.

In designing the units, the principle of the modular system by product has been adopted, thus making each of the professional modules, when completed provides the student with technician operative skills, which can be used for employment purposes.

As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the Curriculum content has been written in behavioural objectives, so that it is clear to all the expected performance of the student who successfully completed some of the courses or the diplomates of the programme. There is a slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which the performance can take

place and to follow that with the criteria for determining an acceptable level of performance. Departmental submission on the final curriculum may be vetted by the Academic Board of the Institution.

Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programme offered throughout the polytechnic system.
The teaching of the theory and practical work should, be integrated.
Practical exercises, especially those in professional courses and laboratory work should not be taught in isolation from theory.
Practical courses should form an integral part of final examination. For each course, these should be a balance of theory to practice of 50:50:-

Continuous assessment 30% (15% quiz and test 15% practical grades)
Final written examination 70% (35% theory and 35% practical)

YEAR ONE (SEMESTER ONE)

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
COM 301	Computer Programming	3	1	-	3	4	
GLT 301	Laboratory Management	2	-	-	2	2	
GLT 302	Instrumentation (General)	2	1	-	2	3	
PYE 311	Atomic and Nuclear Physics	2	-	-	2	2	
PYE 312	Material Science ((Metals and Alloys)	2	-	-	2	2	
PYE 313	Electric Circuit Theory	2	-	-	2	2	
PYE 314	Electromagnetism I	2	-	-	2	2	
PYE 315	General Physics Practicals I	-	-	6	2	6	
MTH 311	Advanced Algebra	2	-	-	2	2	
GNS 301	Use of English III	2	-	-	2	2	
	Total	**19**	**2**	**6**	**21**	**27**	

YEAR ONE (SEMESTER TWO)

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
PYE 321	Thermodynamics	2	1	-	2	3	
PYE 322	Material Science II (Polymers and Ceramics)	2	-	-	2	2	
PYE 323	Electromagnetism II	3	-	-	3	3	
PYE 324	Mechanics	2	-	-	2	2	
PYE 325	Analogue Electronics I	2	-	-	2	2	
PYE 326	Telecommunication Principles	2	-	-	2	2	
PYE 327	Physics Optics	2	-	-	2	2	
PYE 328	Electronics Practicals I	-	-	6	2	6	
MTH 312	Advanced Calculus	2	-	-	2	2	
	Total	**17**	**1**	**6**	**19**	**24**	

YEAR TWO (SEMESTER ONE)

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
PYE 411	Electronics/Instrumentation Workshop	-	-	6	2	6	
PYE 412	Instrumentation I	3	-	-	3	3	
PYE 413	Radio Communication Principles	2	-	-	2	3	
PYE 414	Analogue Electronics II	2	-	-	2	2	
PYE 415	Digital Electronics	2	-	-	2	2	
PYE 416	Solar Energy	2	-	-	2	2	
		2	-	-	2	2	
PYE 417	Acoustics	2	-	6	2	2	
PYE 418	General Physics Practicals II	-	-	-	2	6	
COM 314	Computer Hardware Systems	3	-	-	3	3	
	Total	**16**	**-**	**12**	**20**	**28**	

YEAR TWO (SEMESTER ONE)

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
PYE 421	Instrumentation II and Control	2	-	-	2	2	
PYE 422	Microelectronic Systems	2	-	-	2	2	
PYE 423	Equipment Reliability	2	-	-	2	2	
PYE 424	Electronics Practicals II	-	-	6	2	6	
PYE 425	Seminar	-	-	-	1	-	
PYE 426	Project	-	-	-	6	-	
GNS 402	Literary appreciation and Oral Composition	2	-	-	2	2	
	Total	**8**	**-**	**6**	**17**	**14**	

PROGRAMME:	PHYSICS WITH ELECTRONICS HIGHER NATIONAL DIPLOMA
COURSE:	ATOMIC AND NUCLEAR PHYSICS
CODE:	PYE 311
DURATION:	30 Hours (2 hours Lecture/Week)
UNITS:	2.0
GOAL:	This course is designed to enable students understand the structure of the atom and the nucleus, the nature of atomic and nuclear forces and their application in large scale release of energy

General Objectives: On completion of this course, the student should be able to:

1.0 Understand the particle nature of the atom
2.0 Know the relevant mechanical properties of materials
3.0 Understand the use of spectroscopy in the analysis of the atom
4.0 Understand the nature and application of X-rays
5.0 Understand the general features of nuclear reactions
6.0 Understand the nature of radiological hazards and principles of radiological protection

PROGRAMME: HND PHYSISCS WITH ELECTRONICS			
COURSE: ATOMIC AND NUCLEAR PHYSICS Course Code: PYE 311 Contact Hours 30 UNIT: 2			
Course Specification: Theoretical content			
Week	General Objectives: Understand the particle nature of the atom		
	Special Learning Objectives:	Teachers Activities	Resources
1-2	STRUCTURE OF THE ATOM 1.1 Describe the models of the atom:- Thompson plum pudding model, Rutherfurd's model, model etc 1.2 Derive an expression for the energy changes between levels in hydrogen atom using Bohr's postulate. 1.3 Define Rydberg constant 1.4 Explain the limitations to the Bohr model of hydrogen atom 1.5 Explain the selection rule for the hydrogen atom 1.6 Explain the transitions permitted by the selection rules. 1.7 Draw energy level diagrams for the hydrogen atom	Lecture Describe the structure of atom Explain various models of atom Sketch energy level diagrams for hydrogen atom	Textbook
	General Objectives 2.0 understand the wave nature of the atom		
3	Elements of Quantum Mechanics 2.1 State the postulates of quantum mechanics 2.2 State the Schröedinger's equation 2.3 Explain how schroedinger's equation leads to the wave nature of the atom 2.4 Explain the schroedinger's solution in terms of quantum numbers	Explain the concept of quantum mechanics Lecture Write down scroedinger's equation Discuss scroedinger's equation in relation to quantum	

		quantities	
General Objectives: 3.0 Understand the use of spectroscopy in the analysis of the atom			
Week	**Special Learning Objectives**	**Teacher's Activities**	**Resources**
4-6	**Spectroscopy** 3.1 Explain spectroscopy 3.2 Out line the theoretical foundation of spectroscopy 3.3 Explain how the frequency of any line of the spectrum is proportional to the difference between the values of the energies of the two states of the atom emitting the radiation 3.4 List the types of spectra 3.5 Describe (i)the physical appearance of the spectra lines e.g. sharp or diffuse(ii) the method used in producing the spectra and (iii) the behavior of the lines when the emitting atoms are subjected to external electric and magnetic fields (Zeeman's effect) 3.6 Explain (i) the normal Zeeman's effect and (ii) the anomalous Zeeman's effect 3.7 Explain how to measure magnetic field intensity using zeeman's effect. 3.8 Explain the orbital, spin, and magnetic numbers of the atom. 3.9 Describe the stern-Gerlack experiments to demonstrate electron spin 3.10Solve numerical problems involving the energies of a spectrum, the wavelength, frequency and the wave number between two energy levels	Lecture Discuss the concept of spectroscopy in the study of atoms Explain the characteristics of spectra lines Describe normal and anomalous Zeeman's effect Calculate some simple problems involving the frequency, wavelength etc. between two energy levels Give numerical problems	

General Objectives: 4.0 understand the nature and application of X-rays			
Week	Special Learning Objectives	Teacher's Activities	Resources
7-10	X-Rays 4.1 Describe how x-rays are produced. 4.2 State the wavelength limits of X-radiation 4.3 Explain how the intensity of an X-ray beam is reduced upon passing through matter 4.4 Derive an expression for the intensity, I, of a beam after passing through a thickness X; ie I = IoE where Io is initial incident intensity, and –I is the linear coefficient of absorption. 4.5 Define (i) linear absorption coefficient (ii) mass absorption coefficient of absorption. 4.6 State the relationship between the coefficients in 4.5 above 4.7 Explain how secondary emission occurs when X-rays are absorbed. 4.8 Explain the following forms of emission resulting from X-ray production i Scattered rays ii Electron emission and iii Characteristic emission 4.9 Describe (i) coherent scattering (rayleigh; (ii) Incoherent scattering (Compton) 4.10 Describe the spectrum produced by an X-ray tube. 4.11 State mosley law 4.12 Describe with the aid of a diagram the	Lecture Describe what happens when an X-ray beam is passed through body. Explain the quantities stated in 4.5 Discuss secondary emission in X-radiation Lecture Explain coherent and incoherent scattering. Discuss the characteristic of spectrum produced by an X-ray Describe Mosley's law using diagram	

	characteristic features of Mosley's law 4.13 Explain how Mosley's law may be used to predict some elements of the periodic table 4.14 State the relationship between the accelerating voltage and the quality of X-rays. 4.15 Explain what happens when a parallel beam of X-rays falls on given family of planes in a crystal. 4.16 State Bragg's law 4.17 Derive Bragg's law 4.18 Solve problems relating to the law in 4.17 above. 4.19 Describe how to determine X-ray absorption coefficient	Explain Bragg's law Apply Bragg's law to solve some simple problems.	
	General Objectives: Understand the general features of nuclear reactions		
11-13	**Nuclear Reactions** 5.1 Explain the general features of nuclear reactions 5.2 Explain the conservation laws of nuclear reactions 5.3 Derive an expression for the Q-value of a nuclear reaction 5.4 Define a nuclear cross-section 5.5 Derive an expression for nuclear cross-section 5.6 Determine the cross-section from given data 5.7 Calculate the expectation function of a given reaction 5.8 Define (i) Fissile and (ii) non-fissile nuclear fuels	Lecture Discuss the concept of nuclear reactions Calculate cross-section from supplied information Discuss nuclear fuels	

	5.9 List the type of nuclear fuel for given critical energies 5.10Explain why fissile fuels are less abundant in nature 5.11Explain how the relative abundance o fissile nuclear fuels can be increased by (i) enrichment (ii) conversion and breeding 5.12Classify nuclear reactors in terms of (i) the neutron energies (ii) the moderator or codant used (iii) conversion ratio. 5.13Describe the processes of reactor control	Categorize nuclear reactors in terms of codant, conversion ratio and neutron energies	
14-15	General Objectives: 6.0 Understand the nature of radiological hazards and principles of radiological protection		
	Hazards 6.1 Define the radiological units (i) exposure (ii) dose (iii) dose rate (iv) relative biological effectiveness and (v) dose equivalent 6.2 Describe the biological effects of radiation 6.3 Outline the standards set out by the international commission on radiological protection 6.4 Determine the dose equivalent for any radiation worker using the NCRP standards 6.5 Describe the (i) control of contamination and (ii) disposal of nuclear wastes.	Question and answer Explain the biological effects of radiation Discuss the factors to be considered when disposing nuclear materials and in the control of contamination of pollutants	

PROGRAMME: Physics with Electronics Higher National Diploma

COURSE: PYE 312, Material Science I (Metals and Alloys)

DURATION: 30 Hours (2 hours lecture Week)

UNIT: 2.0

GOAL: This course is designed to provide the students with the knowledge of Basic structure and properties of materials with specific attention to alloys and metals.

On completion of this course, the student should be able to:

1.0 Know the classification of materials.
2.0 Know the relevant mechanical properties of materials.
3.0 Understand simple crystal structures.
4.0 Understand the microscopic crystal nature of metallic surfaces
5.0 Understand the different techniques for X-ray study of materials
6.0 Understand the energy relations and stability of materials
7.0 Know the process of alloying
8.0 Understand the deterioration of metals during use and ways of limiting deterioration.
9.0 Know the different methods of fabricating metals.

PROGRAMME: PHYSICS WITH ELECTRONICS OPTION			
COURSE: Material Science I (Metals and Alloys)		COURSE CODE PYE 312	Contact Hours 30
Course Specification: Theoretical Content			
WEEK	General Objectives: Know the classification of materials		
	Specific Learning Objective	Teachers Activities	Resources
	1.0 Classification of materials. 1.1 Classify materials according to chemical composition, physical feature and internal (crystal) structure. 1.2 Identify common materials with the classes they belong: biological materials, organic materials, inorganic materials etc 1.3 State the distinguishing properties of each class in 1.1 including their uses. 1.4 Explain the need for alloying, coating, cladding and sintering in metals.	Differentiate materials as regards their chemical constituent, physical characteristics and internal structure arrangement.	
WEEK	General Objectives: 2.0 Know the relevant mechanical properties of materials.		
	Specific Learning Objective	Teachers Activities	Resources
2 - 3	Mechanical Properties of Materials. 2.1 State the various mechanical properties of materials. 2.2 Describe methods of determining mechanical properties of materials. 2.3 State Hooke's law of elasticity. 2.4 State the mathematical expressions for Young's modulus, bulk modulus, and rigidity modulus.	Explain, ductility, elasticity, malleability etc. in materials. Discuss the ampercents of Hooke's law. Explain with the aid of a diagram the stress – strain relationship. Explain Young's modulus. Discuss toughness. Discuss the various scales of material hardness.	

	2.5 Identify various features of the stress-strain diagramme. 2.6 Differentiate between tensil strength and yield strength. Describe how to determine the Young's modulus. 2.8 Explain the meaning of ductility both quantitatively and qualitatively. 2.9 Define toughness. 2.10 Explain both Isod and charpy tests for toughness. 2.11 Define hardness. 2.12 Explain the Mineralogists (Moh) scale, the Brindel scale and the Rockwell series for hardness. 2.13 Solve numerical problems.		
WEEK	General Objectives: 3.0 Understand simple crystal structures		
	Specific Learning Objective	Teachers Activities	Resources
	Simple Crystal Structures 3.1 Explain the meaning of translation vector. 3.2 Differentiate between primitive and non-primitive translation. 3.3 Identify the 14 main space lattices. 3.4 Define the unit cell. 3.5 Sketch cubic and hexagonal closed packed structures, indicating equivalent points, crystal directions, and planes given the necessary co-ordinates.	Explain the different main space lattices in crystals. Categorize crystal structures with the aid of diagrams showing crystal directions, and planes. Discuss the various defect experienced in crystals structure. Crystal diagrams showing types of dislocation.	

	3.6 List at least 3 examples of each of the structures mentioned in 3.5. 3.7 Explain the meaning of Schottky and Frenkel defects. 3.8 List other forms of point defects in single crystals. 3.9 Differentiate between point and line defects in crystals. 3.10 Identify dislocations and grain boundaries as different aspects of line dislocation. 3.11 Sketch illustrative diagrammes to demonstrate edge skew and mixed dislocations. 3.12 Explain the uses of the Buerger's vectors and skew axis to characterize the propagation of line defects.			
	General Objective: 4.0 Understand the microscopic crystal nature of metallic surfaces			
	Special Learning Objective	Teacher's Activities	Resources	Teachers Ac
	Microstructure: 4.1 Explain procedure for preparation and examination of specimens of pure metals using microscope. 4.2 Explain highly magnified photographs of metal surfaces as regards grain size	Lecture and demonstrate		
	General Objective: 5.0 Understand the different techniques for X-ray study of materials			
	Special Learning Objective	Teacher's Activities	Resources	
	X-ray Diffraction Techniques: 5.1 Derive the Bragg's condition (equation)	Calculate problems on the spacing and angle of diffraction.		

	for diffraction of x-ray from crystal plane. 5.2 Describe the laue single crystal and powder methods for x-ray diffraction. 5.3 Solve simple problems involving d-spacing and angle of diffraction.		
	General Objective: 6.0 Understand the energy relations and stability of materials		
	Special Learning Objective	Teacher's Activities	Resources
	General Growth and Solidification: 6.1 State the first law of thermodynamics in its quantitative forms dQ = dU + dW and H = Pdv where all symbols have their usual meanings. 6.2 Explain the physical interpretation of both equations in 6.1 above. 6.3 State the Gibb's function (free energy). 6.4 Interpret energy changes during phase transformation using the Gibb's function. 6.5 Sketch cooling curve for (i) water between $110^{o}C$ to $10^{o}C$ and (ii) iron between 1600^{oC} to 900^{oC}. 6.6 Illustrate the relationship between free energy and stability using the cooling curves. 6.7 Explain the concept of nucleation and sustenance of crystal growth using the free energy equation change. 6.8 Obtain critical radius and critical free energy from energy equation change.	Explain the equations in 6.1. Discuss Gibb's function relate free energy adatability using cooling curves. Describe growght of crystal by controlled cooling with/without seeding, Calculate some numerical problems.	

	6.9 Explain practical growth of crystal by controlled cooling without seeding as well as seeding. 6.10 Solve simple numerical problems.		
	General Objective: 7.0 Know the process of alloying		
	Special Learning Objective	Teacher's Activities	Resources
	Alloys: 7.1 State the factors affecting solubility of solid solutions. 7.2 Calculate quantitative percentage of alloy constituent in weight percent and atomic percent. 7.3 Explain the Gbb's phase rule. 7.4 Explain the stability of alloy in terms of Gibo's free energy. 7.5 Interprete a simple phase diagramme of binaiyalloys using a copper alloy, an alluminium alloy and carbon-iron alloys as examples.	Calculate alloy percentage as atomic quantity and weight quantity. Describe the application of Gibb's free energy in the stability of alloy.	
	General Objective: 8.0 Understand the deterioration of metals during use and ways of limiting deterioration.		
	Special Learning Objective	Teacher's Activities	Resources
	Modifying Effect of Service Environment 8.1 Explain the effect of temperature, localized strain, strain rate, fluctuating stress and corrosion as regards mechanical failure. 8.2 Explain the effects of strain hardening, cold work, hot work annealing, heat treatment and tempering, dispersion, hardening, or sintering in improving	Discuss the effect of corrosion, temperature, strain hardening, hardening etc on metals.	

	quality of metals. 8.3 Explain three methods of preventing corrosion including sacrificial anoding		
	General Objective: 9.0 Know the different methods of fabricating metals.		
	Special Learning Objective	Teacher's Activities	Resources
	Fabrication: 9.1 Explain the following methods of forming metals to shape (casting, stretching, extraction spinning, forging and rolling). 9.2 List the advantages and limitations of each of the methods treated in 9.1 above including their effects on the mechanical properties.	List the different ways of fabricating metals.	

PROGRAMME: PHYSICS WITH ELECTRONICS (HND)

COURSE: PYE 313

DURATION: 30 Hours/Week – Lecture – 2, Practical – 0, Tutorial – 0

UNIT: 2.0

GOAL: This course is intended to enable the student acquire basic knowledge of electric circuit theory.

GENERAL OBJECTGIVES:

1.0 Understand network theorems and their application to d.c. electrical circuit.

2.0 Understand a.c. theory and its application to electrical circuit problems.

3.0 Understand power in a.c. circuits.

4.0 Understand network transformation and duality principle and their applications.

5.0 Understand the concept of three phase a.c. circuits.

6.0 Understand the concept of magnetic coupling and its application.

PROGRAMME: HND PHYSCIS WITH ELECTRONICS			
Course: Electric Circuit Theory		Course: PYE 313	Contact Hours: 2 Hours Unit: 2.0
COURSE SPECIFICATION: THEORETICAL CONTENT			
WEEK	GENERAL OBJECTGIVES: Understand Network theorems and their application to d.c. electrical circuit.		
	Special Learning Objectives	Teachers Activities	Resources
1-4	1.1 State kickoff's voltage and current laws. 1.2 Calculate voltage drops and total current at a point in complete circuit applying kickoff's laws. 1.3 State superposition theorem 1.4 Explain the application of superposition theorem. 1.5 Calculate the current in any branch of a network by applying the superposition theorem. 1.6 State Theremins/ theorem. 1.7 Explain the application of Theremin's theorem. 1.8 Replace any circuit by the Theremin equivalent circuit. 1.9 Calculate the following: parameters in any branch of a network applying Helmholty – Theremin's theorem; [a] current [b] internal impedance [c] potential difference across the branch terminals. 1.10 State Norton's theorem 1.11 Explain the application of Norton's theorem. 1.12 Calculate the following parameter in any	Lecture with worked examples. State superposition theorem and Explain it's application. State thevnim's it's application calculate some problems. State millman's theorem, P C. procity theorem. Discuss their application solve problems on network circuit by applying these theorems.	Textbook Textbook

1-4	branch of a network applying Helmholtz – Norton's theorem; [a] the voltage across any branch of the network. [b] internal shunt admittance of the network looking into the branch terminals. 1.13 state [i] Millman's theorem (parallel – generated theorem). [ii] reciprocity theorem. 1.14 Explain the application of theorems in 1.13 above. 1.15 Solve problems on network circuits by applying the theorems above.		
WEEK	General Objectives: Understand a.c. theory and its application to electrical circuit problems		
	Special Learning Objectives	Teachers Activities	Resources
5-7	2.1 Convert the polar form of a.c. signal to j notation. 2.2 Subtract, add, multiply and divide phases using j operator. 2.3 Draw phases diagrams to scale for a.c. circuits, i.e. series and parallel. 2.4 Explain, with the aid of phasor diagrams, the current and voltage relationship in [i] inductive circuits [iii] capacitive circuits. 2.5 Distinguish between inductive and capacitive reactance's. 2.6 Desire an expression for inductive reactance and capacitive reactance. 2.7 Draw voltage and current waver forms on the same axis to show lagging and leading angles. 2.8 Explain, with the aid of phasor diagrams, the current and voltage relationship in series l-c-r	Lecture with worked examples Explain the terms L, C, f_o of an .a.c. circuit. Sketch and explain the curve of impedance against [f] for circuit in series and parallel	Textbook Textbook

	circuit. 2.9 Define [i] series resonance [ii] parallel resonance. 2.10 Sketch the curve of I against f (I = current; f = frequency) for [i] series circuit [ii] parallel circuit.	Explain the terms L, C, f_o an a.c. circuit.	
5-7	2.11 Determine in terms of l and c the resonant frequency, f_o, of an a.c. circuit, where L is inductance and C is capacitance. 2.12 Determine the inductance and the effective series resistance of an inductor in a series resonant circuit. 2.13 Sketch the curve of impedance ( ) against frequency (f) for [i] series circuit [ii] parallel circuit. 2.14 Define Q – factor (i.e. Q = Quality) for [i] series connection [ii] parallel connection 2.15 Calculate the resonant frequency and Q – factor of a series L-C-R circuit. 2.16 Define bandwidth for: [i] series connection [ii] parallel connection	sketch and explain the curve of impedance against [f] for circuit in series and parallel. Calculate resonant frequency and O-factor of L-C-R circuit. Lecture with worked examples	Textbook
5-7	2.17 Calculate the following parameters is parallel L-C-R circuits with known Q – factors_ [a] the resistance of the inductor [b] the dynamic resistance of the circuit. [c] the bandwidth of the circuit.		
WEEL	General Objectives: 3.0 Understand power in a.c. circuits.		
	Special Learning Objectives	Teachers Activities	Resources
	3.1 Determine power in a.c. circuit involving [i] resistance [ii] inductance [iii] capacitance	Lecture with worked examples.	Textbook

8-9	[iv] combination of [i], [ii] and [iii] above. 3.2 Define [i] apparent power [ii] reactive power [iii] true power. 3.3 Define power factor 3.4 Explain the significance of power factor. 3.5 Calculate the power supplied to a device in a.c. circuits using the equation P = VI Cos O; where P is power; V is effective potential difference; I is effective current; O is angle of lag or lead; Cos) is the power factor of the device.	Explain power in a.c. circuits. Define power factor and explain its significance.	
WEEK	General Objectives: 4.0 Understand network transformation and duality principle and their applications.		
	Special Learning Objectives	Teachers Activities	Resources
10-11	4.1 Identify the Y and delta networks 4.2 Transform delta to Y and vice versa. 4.3 Explain duality principle. 4.4 State the rule for finding the duality of a network. 4.5 Transform network using the duality principle.	Lecture with worked examples Explain duality principle and transform network using the duality principle.	
WEEK	General Objectives: 5.0 Understand the concept of three phase a.c. circuits.		
	Special Learning Objectives	Teachers Activities	Resources
12-13	5.1 Explain the meaning of a three – phase circuit. 5.2 Distinguish between three – phase, three wire circuit and three phase, four wire circuit. 5.3 Explain [i] line current [ii] line voltage. 5.4 Determine power in three – phase circuit. 5.5 Calculate the following parameters. In a balanced three phase star-connected (Y) load connected to a three-phase supply and which has	Lecture with worked examples.	Textbook

	an inductive reactance and resistance of know values [a] impedance per phase [b] the phase and line currents [c] the total power consumed.		
WEEK	General Objectives: 6.0 Understand the concept of magnetic coupling and its application.		
	Special Learning Objectives	Teachers Activities	Resources
14-15 14-15	6.1 Define mutual inductance 6.2 Indicate the polarity of coupled coils. 6.3 Define coefficient of coupling. 6.4 Desire equivalent circuits for magnetically coupled coils. 6.5 Define an ideal transformer. 6.6 Derive an equivalent circuit of an ideal transformer. 6.7 Sketch the equivalent circuit diagrams of a practical transformer. 6.8 Draw the phases diagram of: [i] ideal transformer [ii] practical transformer. 6.9 Calculate the induced e.m.f. in the secondary coil of the coils that have a mutual inductance if the current in the primary coil changes. 6.10Calculate: [i] the number of secondary turns [ii] the primary and secondary full load currents. [iii] the volts per turn on both primary and secondary windings of an ideal single phases transformer.	Show Polarity of coup0led coils Explain the concept of magnetic coupling. Define an ideal transformer. Derive an equivalent circuit of the above. Lecture with worked examples..	Textbook Textbook

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: ELECTROMAGNETISM 1	**Course Code:** PYE 314	**Contact Hours: 2hrs** Unit 2.0	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the concept of Static Electricity and its Applications		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-2	1.1 Explain the existence of positive and negative charges. 1.2 Describe briefly charging by friction and induction. 1.3 State the unit of charge. 1.4 Explain repulsion between like charges and attraction between unlike charges. 1.5 State Coulomb's Law. 1.6 Explain super position principle. 1.7 Calculate force between a numbers of charges using superposition principle. 1.8 Define an electric field intensity (E). 1.9 Derive expressions for the electric field intensity for a (i)point charge (ii) a charged sphere (iii) a line charge or charged cylinder (iv) infinite plane of charge (v) charged parallel plates. 1.10 Explain electric flux and electric flux density (or electric displacement). 1.11 State the relationship between electric flux and electric flux density. 1.12 State the unit of electric flux (φ) and electric flux density (D). 1.13 State the relationship between D an E in a linear homogeneous and isotropic medium.	Lecture Discuss the concept of static electricity. State the basic laws of electrostatics. Solve problems on Conlomb's law and supposition principles. Apply the expressions in 1.9 to solve problems on electrostatics. Give worked examples to explain electric flux and electric flux density. Deduce expressions for the relation ship between D and E in a linear homogeneous and isotropic medium. Explain Gauss law.	Textbooks.

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	1.14 Evaluate the total flux out of a closed surface containing charge. 1.15 Evaluate total charge in a volume of charge in a volume of charge density (P) 1.16 State Gauss law. 1.17 Determine the field of a point charge using Gauss law. 1.18 Derive coulomb's law from Gauss law. 1.19 Express Gauss law in differential form. 1.20 Explain the divergence of a vector. 1.21 State the divergence theorem. 1.22 Show that y V.D = P 1.23 Explain the concept of electrostatic potential and energy. 1.24 Write an expression for the p.d between two points in an electrotatic field. 1.25 Express electric field as a potential gradient. 1.26 State Poisson and laplace equations. 1.27 Solve Laplace equation 1.28 Explain electric dipole and dipole moment 1.29 Derive an expression for the (i) potential, (ii) electric field, of an electric dipole.	Derive expression for the Gauss law. Solve problems on electrostatic potential and energy. Apply poisson and lapluce equations to solve practical problems. Give assignments to students.	

WEEK	**General Objectives:** 2.0 Understand the effects of induced charges in dielectrics		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
3,4,5	2.1 Compare conductors and dielectrics. 2.2 Name dielectric materials. 2.3 Describe the behaviour of a dielectric in an electric field. 2.4 Explain polar and non-polar molecules. 2.5 Explain polarization of dielectric materials. 2.6 Define polarization vector (p) and dipole moment (p). 2.7 State the relationship between P and p. 2.8 State the units of P and p. 2.9 Define permitting, relative permitting (or dielectric constant), electric susceptibility. 2.10 State the boundary conditions for D and E. 2.11 Derive an expression for energy stored in dielectrics. 2.12 Calculate D between the conductors of a coaxial cable. 2.13 Define the capacitance of a capacitor. 2.14 Derive expressions for the capacitance of a (i) parallel plate (ii) cylindrical (iii) sphenrical capacitor. 2.15 Calculate the capacitance of capacitors in (i) series (ii) parallel. 2.16 Derive an expression for energy stored in a capacitor 2.17 Explain electrostatic shielding 2.18 Explain electrostatics images.	Demonstrate Explain the characteristics of conductors dielectrics. Explain the relationship between polarization vector and dipole moment. State the importance of energy stored in dielectrics. Explain the operational principle of a capacitor. Solve problems on capacitance of capacitor. Distinguish between electrostatic shielding and images.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	2.19 Solve problems by method of images. 2.20 Describe electrostatic lens 2.21 Explain piezoelectric effect. 2.22 State the applications of piezoelectric materials	Illustrate piezoelectric effect with the aid of suitable diagrams.	
6-7	**General Objectives:** 3.0 Understand the flow of electric charges.		
	3.1 Explain the condition for the existence of current in a conductor 3.2 Derive the relation, I=nevA, for current in ametallic conductor. 3.3 Define current density (J) 3.4 Relate current to surface integral of the current density. 3.5 State Ohm's law. 3.6 Explain mobility of an electron. 3.7 Derive the expression, J = Ẽ (ohm's law at a point) 3.8 Derive V =IR from ohm's conductors 3.9 Compare ohmic and non-ohm conductors 3.10 Define resistance of a conductor. 3.11 Derive the resistance of a coaxial cylindrical conductor obeying ohm's law. 3.12 Compare conductors and semi-conductors. 3.13 Explain Divergence of current density and continuity relation for current. 3.14 Calculate the power dissipated in a resistor.		

WEEK	General Objectives: 4.0 Understand the behaviour of charges moving in a magnetic field		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
8-9	4.1 Explain the concept of magnetic field. 4.2 Define the S.I unit of magnetic field (H). 4.3 Explain magnetic flux and magnetic flux density (B) 4.4 Relate magnetic flux density and magnetic flux. 4.5 Relate magnetic flux density (D) and magnetic field (H) 4.6 Write an expression for the force on a moving charge in a magnetic field. 4.7 Write an expression for the Lorentz force experienced by a moving charge in a region of both electric and magnetic fields. 4.8 Describe the path of a charged particle moving in a magnetic field. 4.9 Derive an expression for the radius of the path described in 4.8 4.10 Apply the expression derived in 4.9 above to spectrograph and accelerators in materials analysis. 4.11 Explain Hall effect. 4.12 Outline the theory of Hall effect meter for measuring magnetic fields.	Lecture. Explain the significance of Biot-Savart law. Solve various problem on magnetic field with current carrying conductors. Derive expression to relate magnetic flux density and magnetic flux. Explain the Gauss law of magnetism. Apply the expressions obtained in 4.6, 4.7,4.8 and 4.9 to solve problem on magnetic field.	
	General Objectives: 5.0 Understand the concept of fields produced by current carrying conductors		
	5.1 Explain the magnetic effect of an electric current 5.2 State Biot-Savart Law 5.3 Derive expressions for the field current carrying conductor as in (i) infinite linear conductor (ii) circular loop (iii) the solenoid (iv) Toroid (Circular solenoid)	Lecture Illustrate the concept of magnetic field with appropriate sketches.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	5.4 Describe the experiment for measuring the magnetic field of along straight current carrying wire and circular loop of wire using Hall effect semiconductor meter. 5.5 Derive expression for Hall voltage in (i) long straight current carrying conductor (ii) circular loop. 5.6 Evaluate total magnetic flux out of a surface enclosing a magnetized medium. 5.7 Explain the following statements: (i) Øs B.ds = o, div B = O. 5.8 State Gauss Law of Magnetism 5.9 Define Inductance of an inductor. 5.10 Derive an expression for the inductance of an inductor. 5.11 Derive an expression for the energy stored in an inductor 5.12 Explain magnetic dipole and magnetic dipole moment (P) 5.13 Calaculate the magnetic dipole moment of a small bar magnetic and a circular current loop. 5.14 Derive the magnetic field of a magnetic dipole. 5.15 State the Ampere's law in both integral and differential forms. 5.16 Define magneto static potential. 5.17 Relate magnetic field to the potential. 5.18 Calculate using Ampere's law the field due to a current in a long straight wire. 5.19 Define the wirl of a vector 5.20 State stoke's theorem.	Lecture Explain the inductance of an indicator. Apply the expressions obtained in 5.10 and 5.11 to solve problems on inductors. Distinguish between magnetic dipole and magnetic dipole moment. State the Ampere's law. Explain the relevance of Stoke's theorem to magnetic field. State the Maxwell's equation.	

WEEK	General Objectives:		
	6.1 Explain ferromagnetic diamagnetic and paramagnetic materials.	Lecture.	
9,10,11	**Special Learning Objectives:** 6.2 List examples of ferromagnetic, diamagnetic and paramagnetic materials. 6.3 Explain the effects of strong non-uniform field on these materials. 6.4 Describe how atoms of a diamagnetic material acquire induced magnetic dipole moments in direction opposite to an applied magnetic field. 6.5 Define the magnetization vector m of a magetic material. 6.6 Define the magnetization of a paramagnetic gas or liquid in terms of the permanent molecular magnetic dipole moments. 6.7 Explain qualitatively domains and curve point. 6.8 Interprete the equation B=Bo+Bm for various magnetic materials.	**Teachers Activities** State the characteristics of ferromagnetic, diagmagnetic and paramagnetic materials. Explain the magnisatium of a paramagnetic gas or liquid. Plot the curve of the equation in 6.8 Define the magnetic susceptibility and permeability. Discuss the making of magnetics. State the relationship between B and H. Distinguish between permanent and temporary magnets. Solve problems on magnetic field and magnetic flun density.	**Resources**
	General Objectives: 6.0 Understand the properties of magnetic materials.		
	5.21 Derive the maxwell's equation $\nabla \times H = J$ starting with Ampere's Law. 3.22 Define magnetic vector potential. 5.23 Derive expressions for the force and torque on coils carrying currents. 5.24 Calculate the force on a current carrying conductor rotating in a magnetic field.		

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
12,14,15	6.9 Estimate the field in a long cylindrical solenoid having n turns per unit length of thin wire carrying current I. 6.10 Derive the total field inside the solenoid as B = uo (BI+M) where mo = permeability of free space and M is magnetization vector. 6.11 Explain magnetic susceptibility and permeability of various materials. 6.12 Interpret the relation B = uo (H=M) for magnets. 6.13 List the materials used in making magnets (permanent and temporary) 6.14 Derive the magnetic field inside a toroid. 6.15 Calculate the field in the gap of a particular electromagnet. 6.16 State the relationship between B and H. 6.17 Draw the B-H curve for (i) soft iron (ii) hard steel. 6.18 Explain the making of permenent magnets. 6.19 Calculate the total flux from a pole of a magnet gives the flux density and the dimensions of the magnets pole surface. 6.20 State practical applications of permanent magnets.	lecture	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: General Physics Practicals I	**Course Code:** PYE 315	**Contact Hours:** **6** Unit 2.0	
Course Specification: Practical Content			
WEEK	**General Objectives:** 1.0 Know the relevant mechanical properties of materials		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1 2 3	1.1 Determine the moment of inertia using Bifilar suspension. 1.2 Determine the Young's modulus of a wire. 1.3 Determine the Young's modulus by bending a beam. 1.4 Determine the Young's modulus from the period of vibration of loaded cantilever. 1.5 Determine the coefficient of Rigidity of a wire statically. 1.6 Determine the coefficient of Rigidity of a wire dynamically.	Conduct practicals on moment of inertia, young's modulus	Metre rule, G-clamp, stop watch, steel wire, weights.
	General Objectives: 2.0 Understand the behavior of sound waves		
4	2.1 Calibrate a narrow necked resonator	Conductor practical on narrow necked resonator	
	General Objectives: 3.0 Understand the concept of static electricity and its applications		
5	3.1 Measure the capacitance of a capacitor using meter bridge. 3.2 Show how a capacitor can be discharged through a neon lamp	Conduct practicals on capacitance of a capacitor and on charging and discharging of a capacitor	Meter bridge capacitors, connecting wires, high tension batteries, neon lamp ammeter, voltmeter.

WEEK	General Objectives: 4.0 Understand a.c theory and applications to electrical circuit problems.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
6	4.1 Determine the inductance and the effective series resistance of an inductor in a series resonance.	Conduct practical on the determination of inductance	Inductor
7	**General Objectives:** 5.0 Understand the use of spectroscopy in the analysis of the atom		
	5.1 Measure the magnetic field intensity using Zeeman's effect.	Conduct practical on Zee man's effect	
8	**General Objectives:** 6.0 Understand the nature and application of X-rays		
	6.1 Determine X-ray absorption coefficient	Conduct practical on xrays	Geiger,muller counter Dosimeter
9	**General Objectives:** 7.0 Understand the nature of radiological hazards and principles of radiological protection.		
	7.1 Determine the dose equivalent for any radiation worker using NCRP standards.	- do -	"
	General Objectives: 8.0 Understand the concept of fields produced by current carrying conductor		
10	8.1 Show Hall effect in a conductor	Conduct practical on current carrying conductor	Heavy duty battery switch, Rheostat

WEEK	**General Objectives:** 9.0 Understand the properties of magnetic materials.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
11	9.1 Determine the properties of magnetic materials	- do -	Mild steel, galvanometer, meters
12	**General Objectives:** 10.0 Understand the importance of combustion		
	10.1 Determine the higher and lower calorific values for products of combustion.	- do -	
13	**General Objectives:** 11.0 Understand the measurement of displacement		
	11.1 Measure displacement using LVDT 11.2 Measure displacement using potentiometer	Conduct practical to measure displacement	Potentiometer Voltmeter
14	**General Objectives:** 12.0 Understand methods of measurement of time, count, frequency and speed.		
	12.1 Measure frequency using the CRO 12.2 Calibrate the frequency scale of a signal generator using (i) CRO (ii) a standard signal generator	Conduct practical to measure frequency and calibrate signal generator	C.R.O. Signal generator
	General Objectives: 13.0 Know the various methods of temperature measurement		
115	13.1 Calibrate the thermocouple for use as a thermometer.	Conduct practical to calibrate a thermocouple	Potentiometer accumulator, key, galvanometer, thermometer, thermocouple.

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Thermodynamics	**Course Code:** PYE 321	**Contact Hours: 3hrs** Unit 2.0	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the first law of thermodynamics		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-2	**First Law of Thermodynamics** 1.1 Write the equation of state of the ideal gas. 1.2 Define specific heat capacities of gas i.e Cp and Cv. 1.3 Explain the concept of work done by an expanding gas. 1.4 Define isothermal and adiabatic processes. 1.5 Interpret the ratio of specific heat capacities, i.e Cp/Cv =ɣ where Cp, Cv are specific heat capacities at constant pressure and volume respectively, ɣ is a constant. 1.6 State the first law of thermodynamics. 1.7 Prove that Cp-Cv = R where R is gas constant. 1.8 Calculate the values of ɣ = Cp/Cv for a gaseous mixture. The gases are assumed to be ideal. Cp, is specific heat capacity at constant pressure, Cv is specific heat capacity at constant volume.	Lecture with worked examples. Give tutorial questions as assignment Give tutorial classes. Explain the equation of an ideal gas. Define specific heat capacity of gas. Explain adiabatic isothermal processes. Prove that cp-cv- = R. Calculate some simple problems. - do -	

	General Objectives: 3.0 Understand the processes by which changes in thermodynamics system are effected		
WEEK	**General Objectives:** 2.0 Understand the second law of thermodynamics		
6-8 3-5	**Special Learning Objectives** **Second Law of Thermodynamics** 2.1 State the second law thermodynamics in the form of Kelvin – Planck's statement. 2.2 Explain the second law using working cycles on the P-V diagram for heat engines and refrigerators.	**Teachers Activities** Explain how changes in a thermodynamic system are effected by processes. Explain the difference between flow and non-flow process. Give tutorial questions as assignment Give tutorial classes.	**Resources**
	2.3 Derive expressions for (i) work done in a car not engine; (ii) efficiency of the car not engine. 2.4 State the clausius statement for the second law. 2.5 Explain how the statements in 2.1 and 2.4 are equivalent. 2.6 Explain the equivalence of the ideal gas temperature and Kelvin temperature. 2.7 Explain the concept of entropy. 2.8 Explain the second law in terms of entropy change for heat engines and refrigerators. 2.9 State the Tds equations. 2.10 Describe the Joule-kelvin effect. 2.11 Obtain conditions for Joule-kelvin effect, using th Tds equation and inversion curves. 2.12 Describe the process of liquefaction of gas, using Joule-kelvin effect.	Explain the 2nd law of thermodynamics in the form of Kelvin-Palankk's statement. With illustration explain the second law using working cycles on the P-V diagram for heat engines. Explain the Glausins statement for the second law. Compare the 2nd law of thermodynamics and Clausins statement of the 2nd law. Explain the Tds equations. Explain the Joule-Kelvin effect. State condition for Joule-Kelvin effect using the Tds equation and Explain the process of liquefaction of gas using the Joule-Kelvin effect.	

	3.3 State the conditions which must be satisfied by steady flow processes. 3.4 Derive the steady flow energy equation (SFEE) $Q-W=\dot{m}[(h_2-h_1)+\frac{C_2^2-C_1^2}{2000}+\frac{(Z_2-Z_1)g}{1000}]$ where h=specific enthalpy; m=mass flow rate into the control volume; c= velocity; z = height above a datam level; g = acceleration due to gravity; Q = heat transfer rate; W=Rate at which work is done. 3.5 Apply the steady – flow energy equation to boiler, condensers, turbines and compressors. 3.6 Derive the non-flow energy equation $U_2 - U_1 = Q-$ Where U_2 is the final energy of a system; U_1 is the initial energy of the system; Q is the quantity of heat transferred and W is the work done. 3.7 Apply the non-flow equation to: (i) constant volume proceses; (ii) constant pressure processes; (iii) adiabatic processes; and (iv) polytropic proceses. 3.8 Define: (i) a reversible process; (ii) irreversible process. 3.9 Distinguish between reversible and irreversible processes. 3.10 Explain why a reversible process is impossible in reality.	State and explain the conditions which must be satisfied by steady flow processes. Drive the formula in 3.4. Explain the steady – flow energy in relation to: (i) boiler (ii) condensers (iii) turbines and (iv) compressors. Drive the no-flow energy equation $U_2 - U, = Q - W$ Explain the non-flow energy equation in relation to: (i) constant volume processes (ii) constant pressure processes (iii) adiabatic processes (iv) polytropic processes. Define: (i) a reversible process (ii) irreversible process. Give the difference(s) between reversible and irreversible processes. Explain why a reversible process is impossible in reality.	
WEEK	**General Objectives:**		
	Special Learning Objectives:	**Teachers' Activities**	**Resources**

WEEK	**General Objectives:** 4.0 Know the Properties of pure substances in terms of the thermodynamic functions		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	Properties of pure substances 4.1 Define internal energy, U. 4.2 Relate internal energy to the first law of thermodynamics. 4.3 Define enthalpy, H = U + PV. 4.4 Explain how the change in enthalpy for an isobaric process is equal to the heat transferred. 4.5 Apply enthalpy to: (i) throttling process; and (ii) a pure substance undergoing a reversible process. 4.6 Define the helmholte function, F = U – TS. 4.7 Explain how the changes of helmoholte function during an isothermal process equal the work done on the system. 4.8 Define the Gibbs's function, G = U – TS + PV 4.9 Derive the Maxwell's equations on the Tds equations by applying the thermodynamic potentials. 4.10 Determine the principal specific heat capacities using Maxwell's equation.	Lecture. Define internal energy, U. Explain the relationship between internal energy and 1st law of thermodynamics. Define enthalpy, H = U + PV. Explain how the heat transferred can be compared to the changes in enthalpy for an isobaric process. Compare enthalpy in relation to: (i) throttling process; and (ii) a pure substance undergoing a reversible process. Define Helmholtz function, F = U – Ts. Define the Gibb's function G = U – Ts + PV. Explain and drive the Maxwell's equations on the Tds equations by applying the thermodynamix potentials. Drive the principal specific heat capacities using Maxwell's equation.	

	General Objectives: 5.0 Understand the third law of thermodynamics		
	Third law of thermodynamics 5.1 State the third law of thermodynamics. 5.2 List the elementary physical consequences of the third law. 5.3 Explain the unattainability of absolute zero. 5.4 Apply the law in 5.1 above to allotropic transformation and glasses.	State and explain the third law of thermodynamics. List the elementary physics consequencies of the 3rd law. Give the application of thermodynamics with relevant examples in relation to (i) transformation (ii) glasses.	

WEEK	General Objectives: 6.0 Understand the importance of combustion as one of the ways of producing thermal energy		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
13 – 15	**Fuels and Combustions** 6.1 Classify fuels according to the phases in which they are handled as liquid, gaseous and solid fuels. 6.2 Explain the nature of each type of fuel, including nuclear fuels. 6.3 Define combustion. 6.4 Calculate the composition change of fuel on combustion in air. 6.5 Deduce air-fuel ratio exhaust gas analysis. 6.6 Define: (i) percentage excess air; and (ii) mixture strength. 6.7 Deduce: (i) enthalpy formation (ii) heat of reaction (iii) performance of combustion equipment using first law of thermodynamics. 6.8 Define calorific value. 6.9 Explain how higher and lower calorific values for products of combustion can be determined. 6.10 Define: (i) flame speed; (ii) ignition temperature. 6.11 Describe the processes of dielectric and induction heating. 6.12 List the application of induction and dielectric heating.	Explain the classification of fuel according to the phases: i.e. gaseous, liquid and solid fuels. Explain combustion. Explain composition change of fuel on combustion in air. Explain (i) percentage excess air; (ii) mixture strength. Explain how with first law if thermodynamics, deduce: (i) enthalpy formation (ii) heat of reaction (iii) performance of combustion. Explain calorific value. Explain (i) flame speed (ii) ignition temperature. Explain dielectric and induction heating. Explain the application of induction and dielectric heating.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Material Science II (polymers and Ceramics)	**Course Code:** PYE 322	**Contact Hours: 3hrs** Unit 2.0	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the chemical process involved in polymerization and it's relationship to observed physical properties of polymers.		
1 – 3	**Special Learning Objectives:**	**Teachers Activities**	**Resources**
	Polymerization and Relevant properties of polymers. 1.1 Explain how monomers join up to form a polymer. 1.2 List the steps involved in polymerization (i.e. initiation, propagation and termination). 1.3 Differentiate between addition polymerization and condensation polymerization. 1.4 Explain the chemical inertness of most polymers and susceptibility of monomers with some functional groups like alcoholic (- OH) and carboxylic (COOH) to chemical reaction. 1.5 State the relationship between the number of carbon (backbone) atoms and melting temperature as well as tensile strength. 1.6 Calculate number average and weight average molecular weight as well as degree of polymerizations.	Lecture. Lecture. Question and answers.	Textbooks.
	General Objectives: 2.0 Know the basic classes of polymers		

	Stability of Polymers (plastics)		
WEEK	**General Objectives:**		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	4.1 Explain the alterations in chemical and physical structure due to exposition of polymers to radiations. 4.2 Describe how radiation damage polymers can be minimized. 4.3 Explain the relationship between the number of carbon atoms and degradation of radiation.		
7 – 9	**General Objectives:** 3.0 Understand the methods of forming plastics into shapes using additives		
	Compounding of plastics 3.1 State the uses of the following additives in the compounding of plastics. (i) Reinforcement (ii) Filler (iii) Plasticizers (iv) Pigments (v) Dyes. 3.2 State examples of each of the additives listed in 3.1 above. 3.3 Explain the processes involved in (i) injection moudling (ii) compression moulding (iii) extrusion moulding (iv) casting (v) drawing (vi) blowing.	Question and answers. Lecture.	
	General Objectives: 4.0 Understand the deterioration of polymers (plastics)		
	2.4 Explain the relationship between (i) branching and density (ii) branching and strength (iii) branching and crystallinity.		

WEEK	**General Objectives:** 5.0 Understand Ceramic materials		
10 – 15	**Special Learning Objectives:**	**Teachers Activities**	**Resources**
	Ceramic materials 5.1 Classify ceramic materials by their (i) chemical components (ii) occurrence (iii) electrical properties (iv) transparency (v) uses. 5.2 State the chemical formulae of commonly occurring ceramic materials in use e.g. silica, limestone, magnetite, alumna, dolomite and typical clay (e.g. koolin, e.t.c.). 5.3 Explain the modifying effects of heat on ceramics. 5.4 State the uses of the following additives in ceramic bodies (i) network modifiers (ii) colouring oxides (iii) reinforcements. 5.5 State the for glazing. 5.6 Describe the process of glazing. 5.7 List components used in forming glazes. 5.8 List the materials used in making glass. 5.9 Explain the thermo-plasticity of glass. 5.10 Describe steps in producing pottery ceramics. 5.11 Explain moulding by (i) die casting (ii) pressing (iii) blowing (for glass). 5.12 State factors involved in the selection of materials for ceramics with respect to (I) cost (ii) properties (iii) ease of forming (iv) durability (v) safety factors.	Lecture.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Electromgnetism II	**Course Code:** PYE 323	**Contact Hours:** Unit 2.0	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the concept of electromagnetic Induction		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1 –2	1.1 Describe the Faraday's experiment on induction 1.2 State Faraday's law of electromagnetic induction. 1.3 State Lenz's law of electromagnetic induction 1.4 Express the Laws in 1.2 and 1.3 above mathematically. 1.5 Explain induced e.m.f. and induced current. 1.6 Derive an expression for induced e.m.f. in (i) a rod moving in a magnetic field. (ii) A rectangular coil (iii) circular coil, moving in a magnetic field. 1.7 Explain practical applications of electromagnetic induction in general of electrical power, and in betatron. 1.8 Deduce the differential form of Faraday's Law from the integral form. 1.9 Explain self-inductance and mutual inductance . 1.10 Derive expressions for self inductance and mutual inductance of circuits. 1.11 Derive an expression for the energy stored in an inductor and total magnetic energy of a system of currents. 1.12 Explain hysterics losses in ferromagnetic materials 1.13 Draw the hysterics loop for soft and hard magnetic materials. 1.14 Explain energy product, and maximum energy product. 1.15 Solve numerical problems.	Explain the law of electromagnetic inductions. Obtain mathematical expressions for laws of electromagnetic induction. Discuss the practical applications of electromagnetic induction. Distinguish between self inductance and mutual inductance. Explain the effect by stresses losses in magnetic materials. Solve problems on electromagnetic induction. .	Textbooks.

WEEK	General Objectives: 2.0 Understand Maxwell's equations and their solutions		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
3-5	2.1 State equation of continuity. 2.2 Interpret the equation in terms of conservation of charge. 2.3 Define displacement current (Id) and displacement current density (Jd). 2.4 State the differential form of Ampere's Law. 2.5 Modify Ampere's Law for currents changing with time. 2.6 Derive the four Maxwell equations. 2.7 State the constitutive relations: $\hat{J}$ = & $\bar{E}$, D = EE and B = M H in linear, isotropic homogeneous media. 2.8 Explain the physical significance of each of the Maxwell's equation. 2.9 Apply Maxwell's equations to fields varying rapidly with time. 2.10 State an example in which fields change rapidly with time. 2.11 Explain electromagnetic radiation in terms of rapidly changing fields. 2.12 Describe electromagnetic radiation.	Explain the relationship between displacement current and displacement current density. Solve problems on ampears law. Obtain the Maxwell's equations and their significance. Discuss the merits and demerits of electromagnetic radiations.	

WEEK	**General Objectives:** 3.0 Understand the properties of electromagnetic waves and their propagation in free space and matter.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
6-8	3.1 State Maxwell's equation in free space 3.2 Solve Maxwell's equation in free space. 3.3 Show that the solution of 3.2 corresponds to waves with speed of light. 3.4 Show that the speed of light in free space is related to μo and Σo (permeability and permittivity of free space). 3.5 Explain the important features of the electromagnetic field by plane waves; wave number, wavelength, period frequency and wave velocity. 3.6 Explain polarized plane wave. 3.7 State the expression for linearly polarized plane wave. 3.8 \illustrate with the aid of diagrams, the relative directions of electric and magnetic field vectors in a plane wave. 3.9 Derive the relation between the electric and magnetic fields in the electromagnetic wave. 3.10 Define the refractive index of the medium. 3.11 Calculate the energy in an electromagnetic wave 3.12 Define (i) Pointing vector (ii) wave group (iii) wave velocity, (iv) phase velocity (v) group velocity. 3.13 Determine the attenuation of plane waves in conductors. 3.14 Explain the skin effect. 3.15 Describe the absorption of plane waves in insulators. 3.16 Define absorption index.	Explain Maxwell's equation in free space. Define the important features of the electromagnetic field. Apply the expression obtained in 3.7 to solve numerical problems. Explain the characteristics of electric and magnetic fields in the electromagnetic wave. Explain the terms listed in 3.12. Give practical examples of skin effects.	

WEEK	**General Objectives:** 4.0 Understand the propagation of high frequency signals along transmission lines.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
9-11	4.1 Define a transmission line. 4.2 Define (i) a lossy line, and (ii) a loss less line 4.3 Explain astematron along transmission line 4.4 Explain the properties of loss line 4.5 Write the voltage equation for a wave traveling along a line. 4.6 Write current equation for a wave traveling along a line. 4.7 Describe commonly used line e.g. coaxial cables and parallel strip lines. 4.8 Calculate capacitance per unit length and inductance per unit length of commonly used lines. 4.9 Derive (i) the characteristic impedance of lines; (ii) speeds of signal propagation along the line. 4.10 Explain reflections at the end of transmission lines. 4.11 Explain standing waves along the lines. 4.12 Calculate voltage standing wave ratio. 4.13 Explain mismatched transmission line. 4.14 Explain impedance matching. 4.15 Explain transmission lines as high frequency circuit.	Illustrate the properties of a transmission line with the aid of diagrams. Apply the equations obtained in 4.5 and 4.6 to solve problems on T- line. Discuss the reflections at the end of transmission line. Obtain the voltage standing wave ratio from a typical transmission line. Explain the application of impedance matching in practical systems.	

WEEK	General Objectives: 5.0 Understand the propagation of high frequency signal wave - guides		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
12-15	5.1 Describe wave guides in common sense 5.2 Compare a wave guide with an antenna in transmitting waves. 5.3 Describe the propagation of waves between conducting planes. 5.4 Explain the reflection and transmission of electromagnetic wave. 5.5 State the boundary conditions. 5.6 Define transverse electromagnetic (TSM) waves. 5.7 Write an expression for acceptance propagation mode. 5.8 Define (i) cut-off frequency modes (ii) wave guide number and (iii) guide wavelength. 5.9 Explain the characteristics of the waves that can travel down a rectangular wave guide. 5.10Write the wave guide equation. 5.11 Write expressions for TEmm wave, where TEmm is transverse electromagnetic wave. 5.12 Write expressions for TMmm wave, where TMmm is transverse mechanical wave. 5.13Explain how Tm_{o1}, TM_{10}, modes vanish in rectangular wave guide. 5.14State the losses in practical wave guides. 5.15Describe the basic structure of a cavity resonator (reflex klystron or magnetron)	Explain the operational principles of waveguides. Discuss the properties of electromagnetic wave. Compare the expressing for TEmm and TMmm waves. Discuss power flow in a practical waveguide. Draw the basic structure of a cartty resonator.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	5.16Calculate the resonant frequency of a rectangular cavity. 5.17State expressions for both electric and magnetic fields in the cavity. 5.18Explain how TE and TM modes are obtained in the cavity. 5.19List the different uses of cavities.	Solve problems using expressions obtained in 5.17. Discuss the application of cavities in practical systems.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS				
Course: Mechnaics		**Course Code:** PYE 324	**Contact Hours: 2 hrs** Unit 2.0	
	2.1 Define position vector. 2.2 Differentiate with respect to time :- (i) position vector (ii) velocity vector 2.3 Differentiate a unit vector with respect to time. 2.4 Integrate a vector with respect to a scalar. 2.5 Express in polar form: (i) displacement (ii) velocity and (iii) acceleration.		Explain position vector. Differentiate these vector quantities with respect to time (i) velocity vector (ii) position vector (iii) unit vector. Integrate a vector with respect to a scalar. Express in polar form: (i) displacement (ii) velocity and (iii) acceleration.	Textbooks.
Course Specification: Theoretical Content				
WEEK	**General Objectives:** 1.0 Understand the concept of Vector Algebra			
1 –2	**Special Learning Objectives:** 1.1 Explain: (i) the Cartesian co-ordinate system (ii) plane polar coordinate system. 1.2 Define (i) unit vector (ii) null vector 1.3 Add and substract vector in Cartesian system. 1.4Explain scalar multiplication of vectors (vector dot product) 1.1 Explain vector cross product. 1.2 Calculate the magnitude of a vector. 1.3 Explain the direction cosine of vectors.		**Teachers Activities** Explain the Cartesian co-ordinate system, plane polar co-ordinate system. Explain scalar and vector quantities. Explain cross and dot product of vectors. Calculate magnitude of a vector. .	**Resources** Textbooks.
	1.4 Calculate the angle between two vectors.		Discuss direction cosine of vector. Calculate angle between two vectors. .	
	General Objectives: 2.0 Understand the concept of vector calculus			

WEEK	**General Objectives:** 3.0 Understand the applications of vector algebra and calculus		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	3.1 Relate second order differential equation to parameters of an oscillating system. 3.2 Derive an expression for work done by a force moving between two points along a path. 3.3 Explain conservative field 3.4 Apply the second order differential equation in harmonic motion, which is under damped, critically damped and over damped. 3.5 Write an expression for potential energy in a conservative field 4.4 Calculate the amplitude and phase in forced oscillation. 4.5 Apply differential equation to R-L-C electrical circuits.	Discuss 4.2 Apply the components of different equation to parameters in 4.1. Calculate expression for amplitude and phase in forced oscillation. Apply differential equation in 4.5.	Textbooks.
7-11	3.7 Write an expression for the conservation of energy. 3.8 State the law of conservation of energy. 3.9 Express linear momentum in Cartesian coordinates. 3.10 Explain the conservation of linear momentum. 3.11 Explain elastic and inelastic collisions. 3.12 Calculate the final velocity of bodies in elastic and inelastic.	Derive expression for conservative. State the law of conservation of energy. Explain linear momentum in Cartesian co-ordinate. Discuss the conservation of linear momentum in Cartesian co-ordinate. Discuss the conservation of linear momentum. Explain elastic and inelastic collision. Solve simple questions on final velocity of bodies inelastic and inelastic.	
	General Objectives: 4.0 Know the application of differential equations to vibrations and oscillation		

	General Objectives: 4.0 Know the application of differential equations to vibrations and oscillation		
	4.1 Relate second order differential equation to parameters of an oscillating system. 4.2 Explain: (i) free oscillations (ii) damped oscillations and (iii) forced oscillations. 4.3 Apply the second order differential equation to harmonic motion, which is under damped, critically damped and over damped. 4.4 Calculate the amplitude and phase in forced oscillation. 4.5 Apply differential equation to R-L-C electrical circuits.	Discuss 4.2. Apply second order differentiate equation to parameters in 4.1, 4.3. Calculate the amplitude and phase in forced oscillation. Apply differentiate equation to equation in 4.5.	Textbooks.

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Analogue Electronics 1		**Course Code:** PYE 325	**Contact Hours; 2 hrs**
Course Specification: Theoretical Content **Semiconductor Diode**			
WEEK	**General Objectives:** 1.0 Understand the Construction, Characteristics and uses of different semiconductor diode		
	Specific Learning Objectives:	**Teachers Activities:**	**Resources**
	1.1 List the various types of diodes and their symbols (i.e p-n junction diode, breakdown (zener) diode, Tunnel (tunnel) diode, photodiodes, and light emitting diodes) 1.2 Describe the construction and V-I characteristic of:- (i) P-N Junction diode (ii) Tunnel diodes (iii) Photodiode 1.3 State the uses of the various types of diodes listed in 1.2 above. 1.4 Compare V-I characteristics of Silicon and germanium diodes under forward and reverse biased conditions. 1.5 Describe an experiment to determine V-I characteristics for silicon and germanium diodes. 1.6 Explain the diode equation. 1.7 Draw the equivalent circuit of a diode (Piecewise-linear approx) 1.8 Derive an expression for diode resistance from the diode equation. 1.9 Describe how to determine the static and dynamic resistance of a silicon diode (general purpose diode) 1.10 Describe how to determine zener diode characteristics.	Explain the principle of operation of (i) p – n junction diode. (ii) Tunnel diodes (iii) photodiode. Explain the V-I characteristics of diodes under former 2 and reverse biased conditions. Solve problems involving diode equation. Give practical applications of diodes. Give practical applications of diodes. . Work Examples.	Textbooks.

WEEK	**General Objectives:** 2.0 Understand the constructional features, distinguish between uses of various transistors		
	Special Learning Objectives	**Teachers Activities**	**Resources**
	Transistor Characteristics 2.1 List the various types of transistors and their symbols (bipolar transistors, field-effect transistors, injunction transistors and silicon controlled rectifiers 2.2 Draw circuit diagrams of properly biased P-n-P, n-p-n bipolar transistors for different configurations. 2.3 Draw characteristics curves for bipolar transistor in: (i) common base (CB) configuration (ii) common-emmitter (CE) configuration (iii) common-collector (C.C) configuration 2.4 Determine from 2.3 above the following (i) imput resistance (ii) voltage gain (iii) current gain (iv) output resistance 2.5 Explain how to measure experimentally the basic parameters of transistor in common-Emmitter configuration. 2.6 Draw the hybrid(h-) parameters equivalent circuit of a bipolar transistor. 2.7 Find Av of a vacuum Tube amplifier stage using (a) the venin equivalent circuit formula (b) Norton equivalent circuit formula. 2.8 Describe the constructional features and equivalent circuit of the mud field effect transistor (FET)	Distinguish between n-p-n and p-n-p bipolar transistors. Explain the characteristic curves for bipolar transistor in common – base, common-emitter and common-collector configurations. Solve problems on bipolar transistors. Discuss the application by brid parameters of equivalent circuit of a bipolar transistor. Explain the principle of operation of field effect transistor (FST). Solve problems on the characteristic curve of field effect transistor. Explain the constructional factors of the Unijunction. Give practical applications of Unijunction Transistor. Explain the principle of operation of silicon controlled rectifier (SCR).	

WEEK	General Objectives		
:	**Special Learning Objectives**	**Teachers Activities**	**Resources**
	2.9 Describe the characteristics curve of the FET in: (i) common source and (ii) common drain configuration 2.10 Describe how to determine the characteristics of FET 2.11 Describe the constructional features and characteristic curves of the injunction transistor (UJT). 2.12 Describe some applications of UJT 2.13 Describe the constructional features and characteristic curve of silicon controlled Rectifier (SCR) Describe applications of SCR		
.	**General Objectives:** 3.0 Understand the analysis and parameters of common-Emitter single stage transistor Amplifiers		
	Single-Stage Transistor Amplifiers 3.1 Draw the circuit diagrams of a common-emmitter amplifier for different biasing methods. 3.2 Describe the operations of a common emitter amplifier. 3.3 Describe using the load line method : (i) the voltage gain (ii) the current gain and (iii) the power gain of a common emitter amplifier. 3.4 Draw the equivalent circuit of a common-emitter transistor amplifier using h-parameters. 3.5 Derive expressions for (i) input resistance (ii) voltage gain and (iii) current gain of common emitter amplifier using 3.4 3.6 Solve numerical problems on common emitter amplifiers	Explain the operation of a single stage transistor emplifier. Discuss the importance of load line method in single-stage transistor amplifiers. Solve problems on single stages transistor amplifiers.	

WEEK	**General Objectives:** 4.0 Understand the analysis and parameters of single stage amplifiers with high input impedance		
	Special Learning Objectives	**Teachers Activities**	**Resources**
4-6	**Amplifier circuits with high inputs impedance.** 4.1 Draw circuit diagram of a common collector amplifier (emitter follower). 4.2 Derive an expression for the input impedance of the common-collect using h-parameter. 4.3 State the properties of a common collector amplifier. 4.4 Describe the bootstrapping technique of increasing the input impedance of an emitter follower. 4.5 Draw the circuit diagram of a FET amplifier in common collector configuration. 4.6 State the properties of FET in 4.5 above. 4.7 Explain some applications of common collector amplifier and FET amplifiers.	Explain the circuit diagrams of a common collector amplifier (emitter follower). Give practical applications of common collector amplifier. Discuss the circuit diagram of FET in single stage amplifier.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Telecommunication Principle Course Code: PYE 326 Contact Hours 2 :0:0			
Course Specification: Theoretical content			
	General Objectives; 1.0 Understand the AM(Amplitude Modulated) wave		
	Special Learning Objectives:	Teachers Activities	Resources

WEEK	**General Objectives:** 5.0 Understand the frequency response of RC coupled amplifiers		
	Special Learning Objectives	**Teachers Activities**	**Resources**
4-6	**Frequency response of RC coupled** 5.1 Describe the frequency response of typical RC coupled amplifiers. 5.2 Determine the band width of an RC coupled amplifier from the frequency response curve. 5.3 Explain the effect of the coupling capacitor on the frequency response curve at low and high frequency. 5.4 Describe the effect of the emitter by-pass conductor on the frequency response of the emplifier. 5.5 Describe how to determine the frequency response curve of an RC coupled amplifier.	Explain the P – C coupled amplifier circuit. Discuss the frequency response curve of an P-C coupled amplifier. Give assignments to students on R-C coupled amplifier.	

	1.1 Write the mathematical expression for an amplitude modulated wave 1.2 Sketch the spectrum of an AM wave from the expression in 1.1 1.3 Write the expression for (i) the transmitted band width (ii) AM radiated power 1.4 Explain why more power resides in the carrier than in the side bands. 1.5 Define modulation index 1.6 Explain the need for transmission using (i) DSB (ii) SSB (iii) DSBSC (iv) SSBSC 1.7 Explain the generation of Amplitude Modulated signals using appropriate electronic circuit 1.8 Write the advantages and disadvantages of (i) SSB (ii)DSB (iii) DSBSC (iv) SSBDC 1.9 Explain the need for SSB pilot carrier	Derive the mathematical expression for an amplitude modulated wave Explain the expression (i) the transmitted band width (ii)AM radiated powers Explain modulation index Explain the concept of transmission in relation to (i) DSB (ii) SSB (iii) DSBSC (iv) SSBSC Explain the generation signals using appropriate electronic circuit Explain the advantages and disadvantages listed in 1.8	Textbook

WEEK	**General Objectives:** 4.0 Understand the principles of digital modulation

	Special Learning Objectives	**Teachers Activities**	**Resources**
10-12	4.1 Explain the importance of digital transmission 4.2 State examples of digital communication systems. 4.3 Explain the following types, with the aid of wave form sketches:- (i) pulse amplitude modulation (PAM) (ii) Pulse position modulation (PPM) (iii) Pulse width modulation (PWM) (iv) Pulse code modulation (PCM) 4.4 Define sampling theorem 4.5 Explain sampling frequency 4.6 Explain, with the aid of block diagram, the operation of PAM transmitter and receiver. 4.7 State the disadvantages of PAM transmission. 4.8 Explain the following transmission methods:- (i) time division multiplexing (TDM) (ii) frequency division multiplexing (FDM) 4.9 State areas of application of each method in 4.8 above.	Explain what is digital transmission. Give examples of digital communication systems. Explain sampling theorem. Explain sampling frequency. Explain the advantages and disadvantages of PAM transmission. Explain the TDM and FDM transmission methods. Give areas of application of TDM and FDM.	

	Special Learning Objectives	Teachers Activities	Resources
4-6	**Frequency Modulated** 2.1 Write expression for frequency Modulated wave form 2.2 Explain the following terms in relation to FM wave form:- (i) frequency deviation (ii) radiated power (iii) frequency swing; (iv) bond width 2.3 Explain why frequency modulated (FM) signal requires wider band width than amplitude modulated (AM) signal. 2.4 Sketch the spectrum of an FM wave form. 2.5 State the advantages and disadvantages of FM over AM 2.6 Describe the production of FM signal using: (i) varactor diode; (ii) reactance valve 2.7 Explain pre-emphasis circuit	Explain frequency modulated wave form and derive expression for it. Explain frequency modulation and amplitude modulation. Explain the advantages and disadvantages of FM and AM. Explain the production of FM. Explain pre-emphases circuit.	
7-9	**General Objectives:** 3.0 Understand AM and FM detection		
	3.1 Show mathematically how a diode can be used to detect an AM signal. 3.2 Explain envelope detection. 3.3 Explain the square law detector. 3.4 Derive expression for output of square law detector 3.5 Sketch the output wave form of square law detector 3.6 Explain, with the aid of sketches, the operation of the following circuit diagrams for FM detection: (i) Foster-Seeley; (ii) Radio detector 3.7 Explain de-emphasis circuit.	Explain how a diode can be used to detect AM signal. Explain how expression can be derived for out put of square law detector. Explain with aid of diagram the output waveform of square law detector.	

WEEK	**General Objectives:** 5.0 Understand different telecommunication system		
	Special Learning Objectives	**Teachers Activities**	**Resources**
	5.1 Explain telecommunication system. 5.2 State types of communication systems such as:- (i) radio broadcasting system (ii) television broadcasting system (iii) satellite communication system (iv) close circuit television system (v) radar system. (vi) Telephone system (vii) Telegraphic system etc. 5.3 Explain, with the aid of block diagram and wave form sketches, the principles of operation of systems listed in 5.2 above.	Explain telecommunication system. Explain types of communication systems. Using diagram and wave form sketches explain the principles of operation of systems.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Physical Optics	**Course Code:** PYE 327	**Contact Hours: 2**	**Unit 2.0**
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the nature of waves		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	1.1 Explain what is meant by wave motion . 1.2 Explain importance of sine wave in physical optics. 1.3 Write equations of wave motion. 1.4 Write down the solution of wave equation. 1.5 Explain the terms (i) phase (ii) phase difference 1.6 Define (i) phase velocity or wave velocity (ii) intensity (iii) amplitude 1.7 Explain when it is appropriate to think of light as consisting of waves and when as consisting of rays. 1.8 Calculate the velocity, frequency and amplitude of wave using equations 1.3 above. 1.9 Describe properties of waves such as :- (i) reflection (ii) refraction (iii) diffraction (iv) polarization (v) interference 1.10 Explain wave packets 1.11 Explain how to determine the velocity of light by various methods :- (i) Romer's (ii) Fizean's and (iii) Michelson's	Explain wave motions. Write equations of wave motion. Explain what is meant by (i) phase. (ii) phase difference. Explain (i) intendits (ii) amplitude and velocity of waves. Calculate the frequency, velocity and amplitude of wave using equation in 1.3 above. Explain the properties of waves such as (i) reflection (ii) refraction, (iii) interference e.t.c. Explain wave packets. Explain methods used to determine velocity of light. .	Textbooks.

WEEK	**General Objectives:** 2.0 Understand the principle of superposition of waves **Special Learning Objectives**	**Teachers Activities**	**Resources**
3	2.1 Add simple sinusoidal waves. 2.2 Explain the superposition of many waves with random phases. 2.3 Describe complex waves. 2.4 Explain the use of Fourier Analysis in resolving complex wave patterns into simple components. 2.5 Explain group velocity.	Discuss the super position of many waves with random phases. Explain complex waves. Discuss the use of Fourier analysis in resolving complex wave patterns.	
	General Objectives: 3.0 Understand the interference phenomenon of waves		
	3.1 State Huygen's principle 3.2 Explain Coherent sources. 3.3 Explain the principles of Young's slit experiment. 3.4 Describe intensity distribution in fringes system. 3.5 Explain the principle of Fresnel's biprism 3.6 Differentiate between the functions of Lody's mirror and Fresnel's mirror. 3.7 Describe Michelson's interferometer 3.8 Differentiate between circular fringes and localized fringes. 3.9 Describe white light fringes. 3.10 Explain visibility of fringes. 3.11 Describe the measurement of lengths using interferometer. 3.12 Explain the working of Twyman and Green interferometer. 3.13 Explain the determination of index of refraction using interferometer. 3.14 Determine the wavelength of light if given the width of the fringes on the screen when a plane light falls on Fresnel's mirrors with an angle between them. 3.15 Explain why in Michelson's interferometer using yellow sodium line coroposed of two wavelengths, the interference patter vanished periodically when there is a translational displacement of one of the mirrors	Explain Huygen's principle. Describe the principles of Yung's slit experiment. Describe the intensity distribution in Fringes system. Differentiate between functions of the mirrors in 3.6. Differentiate between circular fringes and local pad fringes. Explain white light fringes and visibility of fringes. Describe the way Twyman and Green refractometer work. Explain how to determine index of refraction using interferometer. Determine the wavelength of light in 3.14. Explain 3.15. Describe reflection from a plane – parallel film.	

WEEK	**General Objectives:**		
	Special Learning Objectives	**Teachers Activities**	**Resources**
	3.16 Describe reflection from a plane parallel film. 3.17 Identify fringes of equal inclination. 3.18 Explain interference in transmitted light. 3.19 Explain fringes of equal thickness. 3.20 Explain Newton's rings. 3.21 Derive an expression for intensity function. 3.22 Describe chromatic resolving power. 3.23 Explain channeled spectra (Interference filter)	Discuss interference in transmitted light. Explain fringes of equal thickness. Derive an expression for intensity function. Describe chromatic resolving power. Explain 3.2.	

	General Objectives: 4.0 Understand diffraction of waves

	4.1 Explain the term diffraction 4.2 Explain relationship between fresnel and fraunhofer diffraction.	Explain what diffraction means in waves.	
WEEK	**General Objectives:** 4.3 Explain diffraction by a single slit. 4.4 Explain chromatic resolving power of a prism.	Relate between fresnel and	
	Specific Learning Objectives	**Teachers Activities**	**Resources**
	4.5 Explain resolving power of telescope. 4.6 Explain brightness and illumination of star images. 4.7 Calculate resolving power of a microscope. 4.8 Explain phase contrast. 4.9 Write equation for the intensity. 4.10 Explain the difference between single-slit and double slit patterns 4.11 Differentiate between interference and diffraction 4.12 Explain effect of finite width of source slit.	Fraunhofer diffraction. Explain diffraction by a single slit. Discuss chromatic resolving power of a prism. Explain resolving power in telescope. Describe brightness and illumination of star images.	

	4.13 Explain the effect of increasing the number of slits. 4.14 Describe absorption by solids and liquids 4.15 Describe absorption by gases. 4.16 Explain selective reflection 4.17 Explain the relationship between absorption and reflection. 4.18 Describe scattering by small particles 5.7 Explain theory of scattering. 5.8 Explain molecular scattering (blue colour of sky). 5.9 Explain the term scattering index and refractive index.	Explain absorption and scattering of light. Calculate problems involving power of absorption of glasses. Relate equation for the absorption and reflection of light. Explain molecular scattering.	
WEEK	**General Objectives:** 6.0 Understand dispersion of Light		
	Special Learning Objectives	**Teachers Activities**	**Resources**
12-13	6.1 Explain the effects of absorption on dispersion. 6.2 Explain dispersion curve of a surface. 6.3 Derive the electromagnetic equations for transparent media. 6.4 Explain theory of dispersion. 6.5 Describe the nature of vibrating particles and fractional forces.	Explain the effects of absorption on dispersion. Explain dispersion curve of a surface. Explain theory of dispersion. Describe 6.5	
	General Objectives: 7.0 Understand Polarization		
	General Objectives: 3.0 Understand Scattering and absorption of light		
7-9	7.1 Explain polarization by reflection. 7.2 Explain polarization angle and Brewster's law. 7.3 Explain polarization by a pile of plates. 7.4 Define Malus Law. 7.5 Explain polarization by dichroic crystals 7.6 Explain double refraction 7.7 Describe refraction by calcite prism. 7.8 Explain polarization by scattering. 7.9 Calculate (a) reflection coefficients. (b) the degree of polarization of the reflected light using Fresnel equations when natural light falls at Brewster angle on the surface of glass. 7.10 Construct, using Huygen's principle, wavefronts and the propagation directions of ordinary and extra ordination rays in a positive uniaxial crystal whose optic axis: (a) is perpendicular to the incidence plane and parallel to the surface of the crystal; (b) lies in the incidence plane and parallel to the surface of the crystal.	Discuss 4.18 Discuss polarization by reflection. Explain polarization angle and Brewster's law. Explain polarization by a pile of plates. Explain polarization by diachronic crystals. Explain double refraction. Discuss polarization by scattering. Calculate problems in 7.9.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Electronics Practical 1	**Course Code:** PYE 328	**Contact Hours: 6**	**Unit 2.0**
Course Specification: Practical Content			
WEEK	**General Objectives:** 1.0 Understand the Construction, Characteristics of Semiconductor diodes		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1 –2	1.1 Determine the static and dynamic characteristics of a silicon diode (general purpose diode) 1.2 Investigate the working of the diode as a limiter and clamper. 1.3 Determine zener diode characteristics. 1.4 Investigate the working of a diode in single phase, half-wave and full wave rectification.	Conduct practical to determine the characteristics of diodes, and investigate their use on half wave and full wave rectifier .	Diodes (si,Ge), CRO, Zener diode, power supply unit. Multimeter (digital) connecting wires, voltmeter, signal generator etc.
	General Objectives: 2.0 Understand the characteristics of various transistors		
	2.1 Measure the basic parameters (Static characteristics) of a transistor in C-E configuration. 2.2 Measure the basic parameters of a transistor in the C-B configuration. 2.3 Determine the characteristics of FET	Conduct practical to measure the basic parameters of transistors in the C.E and C-B configurations	BC 107 or (108,109) power supply unit, CRO, multimeter (digital)

WEEK	**General Objectives:** 3.0 Understand the parameters of C-E single stage transistor amplifiers

	Special Learning Objectives	**Teachers Activities**	**Resources**
	3.1 Investigate the properties of a transistor power amplifier. 3.2 Determine the voltage and current gains of a C-E amplifier 3.3 Investigate the effect of negative feedback on the gain and frequency response of an amplifier. 3.4 Investigate the effects of positive feedback in the gain and bandwidth of transistor amplifier.	Conduct practicals to investigate the properties/parameters of transistors.	CRO, power supply unit signal generator, probes
	General Objectives: 4.0 Understand the frequency response of RC –coupled amplifier		
	4.1 Determine the high frequency response curve of an RC coupled amplifier. 4.2 Determine the low frequency response of an amplifier	Conductor practical to determine high and low frequency response of coupled amplifier	- do -
	General Objectives: 5.0 Understand the concept of multistage amplifier		
	Determine the frequency of: 5.1 RC- Coupled multistage amplifier 5.2 Transformer coupled multistage amplifier 5.3 Direct coupled multistage amplifier	Conduct practical to determine the frequency of differently coupled amplifiers	- do – with appropriate consumables

WEEK	**General Objectives:** 6.0 Understand the working of Multivibrators		
	Special Learning Objectives	**Teachers Activities**	**Resources**
	6.1 Investigate the behavior of monostable and A stable coupled transistor multivibrators.	Conduct practical to investigate the behavior of mono-and a stable multivibrators	- do -
	General Objectives: 7.0 Understand the behavior of small signal tuned amplifier		
	7.1 Determine the bandwidth in tuned transistor amplifier circuits	Conduct practical determine the bandwidth of tuned amplifier	- do -
	General Objectives: 8.0 Understand the concept of power amplifier		
	8.1 Determine the efficiency of class A transistor power amplifier 8.2 Determine the efficiency of class B transistor power amplifier	Conduct practical to determine efficiency of class A and B power amplifiers	- do - with appropriate consumables

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Electronics/Instrumentation Workshop	**Course Code:** PYE 411	**Contact Hours:**	**Unit 2.0**
Course Specification: Practical Content			
WEEK	**General Objectives:** 1.0 Know electronic components and their specifications.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1 –4	**Electronics Components** 1.1 Identify the following electronic components in relation to their symbols types,, rating, colour coding/valves, and areas of applications: (i) resistors (ii) capacitors (iii) inductors (iv) diodes (Pn-junction, zener, tunnel, LED) (v) transistors (BJT, FET,UJT) (vi) Silicon controlled rectifier (SCR) (vii) Dial (viii) Triac (ix) Integrated, circuit, operational Amplifier Logic gates, rectifiers, Regulators etc (x) Transformers 1.2 Test, using appropriate instruments, the conditions of components listed in 1.1 above. 1.3 Obtain necessary information on components listed in 1.1 above using data books.	Demonstration	Textbook Lab-manual

WEEK	**General Objectives:** 2.0 Understand soldering Techniques		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
5-7	**Soldering Techniques** 2.1 State all precautions to be taken before and when :- (i) Soldering (ii) De-soldering 2.2 Select appropriate soldering lead and soldering iron 2.3 State the importance of flux in soldering 2.4 Solder materials applying correct techniques. 2.5 De-solder materials applying correct techniques. 2.6 Distinguish between a good and dry joint	Explain the precautions necessary to be taken before and during soldering and ele-soldering. State the importance of flux in soldering. Differentiate between a good and a dry joint.	
8-11	**General Objectives:3.0** Understand the layout of components on a Vero board and printed circuit Board (pcb)		
	3.1 Identify different types of boards such as : (i) Vero board (ii) Bread board (iii) Matrix board (iv) Printed circuit board (p.c.b) 3.2 Explain the specific uses of boards listed in 3.1. 3.3 Explain the layout of components on a Vero board from a given circuit diagram. 3.4 Layout components on a Vero board for a given circuit diagram of :- (i) push-pull power amplifier stage (involving use of heat sink (ii) regulated power supply unit (iii) digital devices (using TTL,CMOS etc)	Explain the specific uses of board listed in 3.1. Explain the layout procedure of components on a printed circuit board for a given circuit diagram.	

WEEK	Special Learning Objectives: General Objectives:	Teachers Activities	Resources
	3.5 Explain the layout procedure of components on a printed circuit board for a given circuit diagram. 3.6 Produce a printed circuit board (p.c.b) for any given circuit.		
12-15	**General Objectives:** 4.0 Understand the methods of fault finding in instruments.		
	4.1 Describe the two general methods of fault-finding :- (i) Static testing (point to point testing) (ii) Dynamic testing (signal injection) 4.2 Identify different functional blocks (section) of an equipment from the manufacturers circuit diagram. 4.3 Locate test points from the manufacturers. 4.4 Carry out point to point testing (static) on equipment such as : (i) Power supply unit (ii) Radio receiver (iii) Signal generator etc. 4.5 Carry out dynamic testing using signal injection on equipment listed in 4.4	Demonstration. Explain the two main methods of fault – finding in instruments.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Instrumentation 1	**Course Code:** PYE 421	**Contact Hours:**	**Unit 3.0**
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the characteristics of Measuring Instruments		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1 –2	1.1 Classify instruments into types, ie. Indicating, recording and controlling instruments. 1.2 Explain the factors affecting instrument selection e.g. accuracy precision, resolution, sensivity and range reliability, cost, static and dynamic response, environment and type of output. 1.3 Classify the courses of error in measuring system into: (i) manufacturing errors (ii) design errors (iii) operating errors (iv) environmental errors and (v) application errors 1.4 Explain the importance of calibration	Lecture Demonstrate and supervise. Explain how instrument can be classified into type. Explain the factors affecting instrument. Explain the classification of errors in measuring systems.	Textbook
	General Objectives: 2.0 Understand the composition of a measuring instrument systems.		
	2.1 Explain the importance of basic components of an instrument system i.e. (i) sensing element (ii) amplifying element (iii) signal modifiers or converters and (iv) display. 2.2 State examples of sensing elements (transducer) commonly used. 2.3 Describe broad classes of transducers e.g. electrical, mechanical, pneumatic etc. 2.4 Explain the principle of operation of various types of transducers. 2.5 Explain factors for selecting transducers for measuring	Lecture. Explain the importance of basic componets of an instrument system. Explain the term transducer. Explain the broad classes of transducer. Explain the factors affecting transducers.	

WEEK	General Objectives: Special Learning Objectives:	Teachers Activities	Resources
3-6	3.1 Explain how the following static performance parameters of measuring systems can be determined. (i) sensitivity (ii) accuracy and precision (iii) hysteresis (iv) dead-band etc. Purposes e.g. nature of measurement, environment consideration, cost availability etc. 2.6 State examples of simple electrical, hydraulic and mechanical amplifying elements 2.7 Explain the principles of operation of each classes of amplifying element listed in 2.6 2.8 State examples of signal converters (e.g. a rack and pinion gear, a bridge circuit or charger amplifier etc) 2.9 Explain the principle of operation of each class of signal converters in 2.8 above. 2.10 State areas of application of each type of signal converter. 2.11 State examples of display units. 2.12 Explain board classification of display e.g. analog and digital. 2.13 Explain the principle of operation of the various types of display unit. 2.14 Explain factors considered in selecting display unit for measuring purposes.	Explain the concepts of (i) sensitivity (ii) accuracy and precision (iii) hysteresis (iv) dead-band etc. as related to static performance of measuring system. Give examples of simple electrical hydraulic and mechanical amplifying elements. Give example of signal converters. Explain the principle of operation of signal converters. Give the practical application of each type of signal converter. Explain the term display units. Explain the principle of operation of the various types of display unit.	
	General Objectives: 3.0 Know the importance of static and dynamic performance of measuring systems		

	Special Learning Objectives:	Teachers Activities	Resources
WEEK	**General Objectives:** 5.0 Understand the methods of measurements of force, torque and pressure		
	3.2 Explain how parameters associated with dynamic performance of measuring systems can be determined e.g. step response and frequency response. 3.3 Explain the determination of step response to (i) first-order system (ii) second order system 3.4 Explain how to determine the frequency response of a second order system		
8-9	**General Objectives:** 4.0 Understand the measurement of displacement		
	4.1 Classify displacement measuring devices into electrical and mechanical types. 4.2 State examples of each type in 4.1 above. 4.3 Explain the construction and principle of operation of the dial – test indicateor. 4.4 Explain the advantages and disadvantages of the dial test indicator. 4.5 Explain with the aid of a sketch the principle of operation of a "float" as a simple displacement measuring device. 4.6 Explain the principle of operation of the linear variable differential transformer (L.V.D.T.). 4.7 Explain the operation of potentiometers (linear or rotary) as a displacement measuring device.	Lecture. Explain the electrical and mechanical types of displacement measuring devices. Give examples of electrical and mechanical type of displacement measuring devices. Explain the terms dail-test indicator. Explain how the following devices work (i) dial-test indicator (ii) float (iii) potentio-meters.	

	Special Learning Objectives:	**Teachers Activities**	**Resources**
10	5.1 Describe how force can be measured using the following methods i.e. (i) gravity-balance (ii) fluid-pressure (iii) deflection of elastic element and (iv) Piezoelectric electric elements 5.2 Describe pressure measurement using:- (i) piezometer and manometer (ii) deflection and strain of elastic elements.	Explain how force can be measured using the following methods in 5.1. Explain how pressure can be measured using (i) piezometer and manometer (ii) deflection and strain of elastic elements.	
11-12	**General Objectives:** 6.0 Know the methods of measurement of time, counts, frequency and speed.		
	6.1 Describe the method of time measurement using; (i) measuring oscillators (ii) industrial timing method using stop watches or stop clocks. 6.2 Describe operation of counting devices such as: (i) mechanical counters and (ii) electrical counters 6.3 Explain the principles of signal frequency measurement using: (i) Cathode ray oscilloscope (C.R.D) (ii) Digital methods 6.4 Describe methods of angular-velocity measurement using:\ (i) mechanical tachometers (ii) the electromagnetic pulse technique (iii) the opto-electronic technique (iv) the stroboscope	Lecture. Explain how time can be measured using: (i) measuring oscillators. (ii) industrial timing method. Explain the method of angular-velocity measurement.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Radio Communication Principles	**Course Code:** PYE 413	**Contact Hours:**	**Unit 2.0**
Course Specification: Theoretical Contents			
WEEK	**General Objectives:** 1.0 Know various frequency bands within the radio spectrum		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	Radio Frequency Spectrum 1.1 List the frequency/wavelength ranges allocated to each of the following bands:- (i) Extremely low frequency (e.l.f.) (ii) Very low frequency (v.l.f.) (iii) Low frequency (l.f.) (iv) Medium frequency (m.f.) (v) High frequency (h.f.) (vi) Very high frequency (v.h.f.) (vii) Ultra high frequency (u.h.f.) (viii) Super high frequency (.s.h.f.) (ix) Extremely high frequency (e.h.f.) 1.2 State the areas of application of each frequency range listed in 1.1	Lecture and Demonstrate. Explain the application of each frequency range in 1.1	Textbook
3-4	**General Objectives**: 2.0 Understand the principles of electromagnetic wave radiation		
	Electromagnetic wave radiation and Aerials 2.1 Define an isotropic radiation. 2.2 Explain the function of an aerial as a radiation 2.3 Explain the current and voltage distribution of a dipole 2.4 Define the following parameters of an aerial: (i) gain (ii) Band width (iii) Effective radiated power (iv) Radiation resistance and (v) Impedance	Lecture with worked examples. Explain what an Isotropic radiation means. Explain the parameters in 2.4.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	2.5 Explain with the aid of a sketch, radiation pattern of an aerial. 2.6 Identify various types of aerials e.g. yogi, parabolic, etc. 2.7 State the area of the aerial mentioned in 2.5 above. 2.8 Explain the factors guiding the choice of aerials. 2.9 Explain the effect of operating frequency on aerial dimensions and performance.	List various types of aerials and discuss factors to be considered in the choice of aerials. Discuss the importance of frequency on arial dimensions of performance.	
	General Objectives: 3.0 Understand the principles of radio wave propagation		
	Radio Wave Propagation 3.1 Describe the following types of waves: (i) ground waves (ii) Sky waves (iii) Space waves 3.2 Describe the composition and usefulness of the troposphere in propagation. 3.3 Describe the effects of the troposphere on the propagation below 30MHz. 3.4 Explain the various layers of the ionosphere such as :- (i) D-layer (ii) E-layer (iii) F-layer	Lecture. Explain the various types and characteristics of radio waves. Discuss the importance of troposphere in radio wave propagation.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
5-6	3.5 Explain the following types of operating propagation frequency:- (i) critical frequency (ii) maximum frequency (iii) Optimum working frequency 3.6 Describe radio wave propagation for different applications such as:- (i) broadcasting (ii) paint to paint communication, etc.	Discuss the various frequencies at which radio waves can be propagated. Explain the relevance of radio wave propagation in broadcasting etc.	
	General Objectives: 4.0 Appreciate the principles of modulation and demodulation		
	Modulation and demodulation 4.1 Distinguish between carrier and modulating signals. 4.2 Explain modulation 4.3 Describe the formation as: (i) an amplitude modulated carrier (ii) a frequency modulated carrier (iii) a pulse modulated carrier 4.4 State the merits and demerits of AM, and FM signals. 4.5 Explain the application of AM and FM signals. 4.6 Sketch a properly labeled (i) sine wave amplitude modulated waveforms. (ii) pulse amplitude modulated wave forms. 4.7 Explain how to obtain frequency spectrum and bandwidth of an amplitude modulated waveform produced from given (i) sine wave modulating frequency (ii) speech modulating frequencies 4.8 Describe qualitative "Demodulation" as the reverse process of modulation.	Lecture with worked examples. Discuss modulation . Explain the types of signal carriers. List out their advantages and disadvantages. Sketch a sine wave for (i) AM wave pathern, (ii) PM wave characteristics. Explain Demodulation.	

WEEK	**General Objectives:** 5.0 Understand the working principles of Radio Transmitter		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
11-12	**Radio Transmitter** 5.1 Draw a labeled block diagram of an amplitude modulated (AM) transmitters. 5.2 Explain the function of each stage of 5.1 5.3 Explain the significance and principles of frequency multiplication in radio transmitters. 5.4 Describe the circuit to produce AM signals 5.5 Describe the need for an amplifier driver stage. 5.6 Describe the operation of a simple hf power amplifier with aerial coupling arrangement. 5.7 Describe practical procedures for matching an aerial to a radio transmitter.	Lecture. Discuss the principles involved in frequency multiplication in radio transmitters. Explain the circuitry associated with amplitude – modulated signals. Discuss how a rf frequency power amplifier with aerial – amplifier arrangement.	
	General Objectives: 6.0 Understand the working principles of radio receiver		
	6.1 Draw a labeled block diagram of a straight radio receiver. 6.2 Describe the function of each stage of the straight radio receiver such as (i) r.f variable – tuned amplifier; ii) demodulator iii) a.f amplifier 6.3 Explain, with the aid of simple circuit arrangement, the compositions and mode of action of the following:- (i) r.f variable tuned amplifier (ii) demodulator (iii) a.f. amplifier feeding loud speaker	Lecture with the aid of a diagram: (i) Straight radio receiver. (ii) circuit arrangement of a) r.f. variable – tunned amplifier. (b) demodulator (c) a.f. amplifier feeding loud speakers.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
13-15	6.4 Describe some of the limitations of the straight radio receiver such as: (i) ganging multiple r.f. signals (ii) selectivity (iii) Bandwidth requirement 6.5 Explain, with the aid of a block diagram the working principle of super heterodyne radio receiver. 6.6 Explain the choice of intermediate frequency (i.f.) 6.7 Describe the characteristics and circuit arrangement of : (i) i.f. amplifier (ii) a local oscillator 6.8 Explain the problem of second channel (image) interference.	Lecture and solve problems. Explain the disadvantages of slvaght radio receiver. Discuss with the aid of a diagram: (i) the working principle of superhetherodyne radio receiver. (ii) I.F amplifier and an oscillator circuitry.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Analogue Electronics II	**Course Code:** PYE 414	**Contact Hours:**	**Unit 2.0**
Course Specification: Theoretical Contents			
WEEK	**General Objectives:** 1.0 Understand the Concept of Multistage Amplifiers		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1 – 3	**Multistage Amplifier** 1.1 Define a multistage amplifier circuit. 1.2 State the different methods of amplifier coupling e.g. RC coupling, direct coupling and transformer coupling. 1.3 Draw the circuit diagram of OM RC coupled two stage transistor. 1.4 Explain with the aid of a sketch, the frequency response of a two stage RC coupled amplifier. 1.5 Derive the relationship between the gain and bond width of a multistage RC coupled amplifier 1.6 Draw the circuit diagram of a transformer coupled multistage amplifier. 1.7 Explain, with the aid of sketch, the frequency response of a transformer coupled amplifier. 1.8 Draw the circuit diagram of a direct coupled multistage amplifier 1.9 Explain, with the aid of a sketch the frequency response of direct coupled multistage amplifier 1.10 Compare the advantages and disadvantages of different types of coupling in 1.2 above.	Distinguish between single stage and multistage amplifiers. Explain the frequency response curve of a two stage RC coupled amplifier. Explain the basic features of a transformer coupled multistage amplifier and direct coupled multistage amplifier. State the applications of different types of coupling in 1.2 above.	Textbook

WEEK	General Objectives		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
4-5	**Small Signal Turned Amplifier** 2.1 Draw the circuit diagram of a tuned transistor amplifier 2.2 Describe the operation of a tuned amplifier. 2.3 Calculate the resonant frequency of the tuned circuit 2.4 Draw the circuit diagram of a double tuned amplifier circuit. 2.5 Describe the principle of operation of a double tuned amplifier. 2.6 Explain how to determine the bandwidth in tuned transistor amplifier circuits. 2.7 List areas of applications of tuned amplifiers e.g. (i) r. f. amplifiers in radio receiver (ii) Video amplifiers	Explain with the aid of a sketch, the operation of a tuned amplifier and double-tuned amplifier circuit. Discuss the characteristic curve of a tuned transistor amplifier circuit.	
6-8	**General Objectives:** 3.0 Understand the Concept of Direct Coupled Amplifiers		
	Direct Coupled Amplifiers 3.1 List three class of direct coupled amplifiers e.g. (i) Darlington- connection (ii) Differential amplifier (iii) Operational amplifier 3.2 Draw the circuit diagram of a Darlington (pair) amplifier 3.3 Describe the operation of the circuit in 3.2 3.4 Derive expressions using h-parameters for: (i) Input Impedance (ii) Current gain (iii) Output impedance	Explain the principle of a Darlington (pair) amplifier. Solve problems on the h-parameters for a Darlington pair amplifier.	

WEEK	**General Objectives:** 5.0 Understand the concept of Feedback as I.T. affects the performance of the Transistor Amplifier		
	Specific Learning Objectives:	**Teachers Activities**	**Resources**
12-13	**Negative Feedback Amplifier** 5.1 Define feedback 5.2 Derive an expression for voltage gain in negative feedback amplifier 5.3 Explain the effect of feedback on (i) voltage gain (ii) Distortion (iii) Band width (iv) Input Impedance (v) and Output Impedance 5.4 Classify using black diagrams negative feedback into: (i) Series voltage feedback (ii) Series current feedback (iii) Parallel voltage feedback (iv) Parallel current feedback 5.5 Describe with the aid of circuit diagrams negative feedback amplifiers listed in 5.4	Explain with the aid of diagram the negative fed back amplifiers. Illustrate the working principle of a balanced and unbalanced, differentiate amplifier with suitable diagrams. State the applications of negative feedback amplifiers listed in 5.4. Derive the expression for common-mode rejection ratio (CMRR) of a differential amplifier.	
	General Objectives: 4.0 Understand the concepts of Power Amplification		
9-11	**Power Amplifiers** 4.1 Explain the importance of large signal amplification. 4.2 Explain the classification of power amplifiers i.e. (i) class A mode (ii) class B mode (iii) class AB mode (iv) class C mode 4.3 Describe the method of determining the power output and the efficiency of an amplifier. 4.4 Describe the operation of the push-pull power amplifiers in the: (i) class A mode (ii) class B mode (iii) class AB mode 4.5 Compare the merits and demerits of classes of push-pull power amplifiers listed in 4.4 above.	Explain each class of power amplifiers. Illustrate the working principle of the push-pull amplifiers with suitable circuit diagrams. State the practical application of classes of push pull power amplifiers.	

PROGRAMME: HND PHYSICS WITH ELECTRONICS		
Course: Digital Electronics	**Course Code:** PYE 415	**Contact Hours: 2Hrs Unit 2.0**
Course Specification: Theoretical Contents		
WEEK	**General Objectives:** 1.0 Understand the working principles and applications of the Operational Amplifier	

	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-3	1.1 Describe the basic operational Amplifier (OP AMP) with aid of block diagram. 1.2 Explain the characteristics of voltage operational Amplifiers. 1.3 Describe the characteristics of OP AMP in the inverting and non-inverting modes. 1.4 Explain the concept of virtual ground in OP AMP. 1.5 Write the expression for the gain of OP AMP for differential input. 1.6 Write the expression for the input and output impedance. 1.7 Define the voltage supply rejection ratio. 1.8 Describe the frequency response of an OP AMP. 1.9 Define the following terms: (i) input off – set voltage (ii) input bias current (iii) slow rate 1.10 Explain the following OP AMP parameters, i.e. open loop voltage gain, output resistance without feedback, differential input resistance, input offset voltage, input bias current and input offset current, common mode rejection ratio, and slow rate. 1.11 Explain the manufacturer's data specification for an OP AMP in terms of :	Explain the working principle of operational amplifiers. Illustrate the characteristics of OPAMP with the aid of diagrams. Use the expressions derived in 1.5 and 1.6 to solve problems on OPAMP. Discuss the importance of OP-AMP parameters listed in 1.9 and 1.10. Explain the OP-AMP specifications in the manufacturers' data sheet.	Textbook

WEEK	**General Objectives:** Know the Operational Principle of Oscillator		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
14-15	**Oscillators** 6.1 Define positive feedback. 6.2 Derive the expression for voltage gain in positive feedback i.e. $A_f = \frac{A}{1 - AB} L\emptyset$ Where A – gain without feedback B - Feedback factor Ø - Phase shift 6.3 State the conditions for oscillation, i.e. AB = 1 6.4 Describe the various types of oscillator circuits (i) Colpitts oscillator (ii) Hartley oscillator (iii) Tuned output oscillator (LC oscillator (iv) Phase shift oscillator 6.5 Explain the factors affecting frequency stability of an oscillator. 6.6 Describe the principle of operation of crystal oscillator.	Explain positive feedback using an oscillator circuit. Explain the working principles of various types of oscillator circuit listed in 6.4 Discuss type frequency stability of an oscillator. State the application of crystal oscillator in practical systems.	

	2.1 Describe the operation of transistor as a switch. 2.2 Explain the switching times of a transistor. 2.3 Define multivibrator. 2.4 Explain the different classes of multivibrator.	Explain the principle of operation of a multivibrator.	
WEEK	**General Objectives:**		
14-15	**Special Learning Objectives:** (i) monostable (ii) astable (iii) bistable. 2.5 Describe with the aid of circuit diagrams and waveform sketches, the operation of astable multivibrator 2.6 Describe, with the aid of circuit diagrams and waveform sketches, the operation of bistate multivibration. 2.7 Describe, with the aid of circuit diagrams and waveform sketches the operation of monostable multivibrator. 2.8 Explain the applications of the different types of multivibrators, i.e. (i) monostable as time base generator. (ii) bistable as a counter. (iii) astable as a signal generator. 2.9 Describe the RC waveform shaping circuits (differentiating and integrating) 2.10 Describe the RL waveform shaping circuits. (differentiating and integrating.)	**Teachers Activities** Discuss the merits and demerits of monostable, astable and bistable multivibrators. Give assignments to students on multivibrators. State the importance of multivibrators in the electronic systems. Explain the waveform shaping circuits. Discuss the applications of OP-AMP in practical systems. Distinguish between RL and RC waveform shaping circuits.	**Resources** Lecture Textbook
	(i) the rated output (ii) power dissipation (iii) input overload protection (iv) supply current drain (v) amplifier noise 1.12 Describe the effect of cross-over distortion in the design of equipment using operational amplifier 1.13 Explain the use of OP AMP as: (i) an integrator (ii) a differentiator (iii) an instrument amplifier (iv) current to voltage converter (v) precision voltage regulator etc.	Explain how to minimize cross-over distortion in operational amplifier. Illustrate with the aid of diagrams, the connection of OP-AMP as listed in 1.13.	
	General Objectives: 2.0 Understand the operation of multi vibrator and wave shaping circuits		
	2.11 Describe the operation of clipping and clamping.	Explain the operation of clipping and clamping circuits with suitable diagrams.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	3.7 Explain the term Binary coded Decimal (BCD) 3.8 Explain the construction of the gray code and its use in automatic machines. 3.9 Explain the operation and application of decoders 3.10 Explain the formation of Karnaugh mapping. 3.11 Apply Karnaugh mapping to simplify problems	Give worked examples to students of BCD. Solve problems using Karnaugh maps.	Textbook
11-13	**General Objectives:** 4.0 Understand the operation of basic logic gates and their applications.		
	4.1 Explain the two distinguish levels of any logic gate. (i) high level (ii) low level 4.2 List the six basic logic functions, i.e. (AND, OR, NOR, NAND, NOT and EX-OR) 4.3 Explain , with the aid of symbols and truth table, the functions of the gates listed in 4.2 4.4 Describe the rise and decay times for ideal and real pulses 4.5 Explain the operation of the flip-flop gate as a latch. 4.6 Explain, with circuit diagrams for implementing the building blocks, i.e. (i) Diode logic (DL) (ii) Resistor-Transistor Logic (RTL)	Explain the logic gate and its levels. Give worked examples to explain the functions of the gates listed in 4.2. State the advantage and disadvantage of the building blocks listed in 4.6. Solve problems to implement the logic functions.	Textbook

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
14-15	(iii) Direct-coupled Transistor Logic (DCTL) (iv) Diode Transistor Logic (DTL) (v) Transistor – Transistor Logic (TTL or T^2L) (vi) Emitter – Coupled Logic (ECL) 4.7 State the applications of logic gates in 4.6 4.8 Implement the logic functions using gates.	Lecture	Textbook
	General Objectives: 5.0 Understand the fabrication of Integrated circuits		
	5.1 Explain the process of fabrication of integrated circuits (IC) (i) Transistors (ii) Diodes (iii) Capacitors (iv) Resistors (v) Inductors 5.2 Explain the terms: (i) Small scale integration (SSI) (ii) Medium Scale Integration (MSI) (iii) Large Scale Integration (LSI) (iv) Very Large Scale Integration (VLSI)	Explain the advantages of IC fabrication or discrete components. State the general applications of integrated circuits.	Textbook

Programme: Physics with electronics.
Higher National Diploma

Course: PYE 416, Solar Energy

Duration: 30hours (2 hours lecture/week)

Unit: 2.0

Goal: This course is designed to enable students acquire knowledge of solar Energy and it's potentials.

On completion of the course the students should be able to :

1.0 Understand Solar Radiation and Factors affecting its availability on the earth's surface
2.0 Understand heat transfer fundamentals for solar energy application
3.0 Understand basic properties of solar collectors and their uses
4.0 Understand various methods of Solar Energy Conversion
5.0 Understand the various methods of Storing Solar Energy
6.0 Understand specific applications of Solar Energy

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Solar Energy	**Course Code:** PYE 416	**Contact Hours:** Unit 2	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand Solar Radiation and Factors affecting its availability on the earth's surface		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-3	**Solar Radiation** 1.1 Explain using the celestial vault represented in the horizontal system. (i) Zenith; (ii) nadir; (iii) celestial poles; (iv) vertical circles; (v) celestial equator; (vi) hour circles; (vii) almucantor; (viii) altitude; (ix) azimuth. 1.2 Explain solar declination. 1.3 Define (i) hour angle; (ii) apparent solar time (iii) clock time (local time). 1.4 Describe qualitatively the structure of the sun. 1.5 Describe the motion of the earth in space. 1.6 Explain how the earth's motion leads to variation of solar energy incident on the earth's atmosphere. 1.7 Define (i) direct (beam radiation) (ii) diffused radiation (iii) total (global) radiation. (iv) solar constant; (v) air mass. 1.8 Sketch the spectral distribution curves for solar radiation collected: (i) above the earth's atmosphere (ii) at sea level with air mass = O; (iii) at sea level with air mass = 1; (iv) at sea level with air mass = 2 1.9 Explain the causes of the differences in the curves in 1.8. 1.10 Describe methods for estimating total, direct and diffused radiation.	Lectures Use questions and answer techniques. Explain solar declination. Define hour angle, apparent solar time and clock time. Discuss the motion of the earth in space. Explain the various ways of estimating direct radiation.	*Charts of sun structure. *Iso radiation map of Nigeria. *Dynamometer *Pyrheliometer *Charts of various types of solar collectors. Flat plate collector Concentrator collector

WEEK	**General Objectives**:		
	Special Learning Objectives	**Teacher's Activities**	**Resources**
	1.11 Describe the solar map of Nigeria (isoradiation map) 1.12 Describe the principle of operation of a dynamometer. 1.13 Describe the principle of operation of a pyrheliometer.	Explain the solar map of Nigeria. Discuss the principle of operation of a pyranometer. Lectures	
4-5	**General Objectives**: 2.0 Understand heat transfer fundamentals for solar energy application		
	Fundamentals of Heat Transfer 2.1 Describe quantitatively heat conduction through: (i) flat plate; (ii) the wall of cylinder. 2.2 State the general equation, which describes the energy exchange by convection. 2.3 Describe quantitatively forced convection (i) over a flat plate; (ii) over a circular cylinder; (iii) through a tube. 2.4 Describe quantitatively natural convection over (i) flat plate; (ii) circular cylinder. 2.5 Describe the radiation exchange between surfaces (Lambert law)	*Lecture *Give tutorials Explain the way s at which heat passes through flat plate, cylinder. Explain forced convection over a flat plate and through a tube. Discuss Lambert law	- do -

	Solar Energy Conversion Techniques 4.1 Describe the technique of conversion of solar energy to electrical energy by use of fuel cells.	*Lecture Discuss how fuel cells can be used to convert energy to electrical energy.	- do -
WEEK	**General Objectives**: 3.0 Understand basic properties of solar collectors and their uses		
	Specific Learning Objectives	**Teacher's Activities**	**Resources**
6-8	**Properties of Collectors** 3.1 Describe the set back effect, plate emittance (i.e. by body, absorptance, insulator and opaqueness) 3.2 Describe the structure and use of concentrators in harnessing solar radiation. 3.3 Describe the method of liquid healing by solar energy. 3.4 Describe porous and non-porous solar air heaters.	*Lecture Explain the usefulness of concentrators in solar energy. Itemize the applications of solar air heaters in 3.5. List the applications of solar pond Describe a solar furnace	- do -
	3.5 Explain the application of solar air heaters in: - (i) Space heating (ii) Air conditioning building utilizing desiccant beds or an absorption refrigeration process; (iii) Drying agricultural produce and lumber; (iv) Heating green houses; (v) Heating source for a heat engine. 3.6 Describe the principles of operation of a solar pond. 3.7 Explain two applications of the solar pond. 3.8 Describe a solar furnace.	*Give tutorials	
	General Objectives: 4.0 Understand various methods of Solar Energy Conversion		

WEEK	**General Objectives**:		
	Special Learning Objectives	**Teacher's Activities**	**Resources**
	4.3 Describe the natural conversion of solar energy to chemical energy in plants (Biomass). 4.4 Explain the conversion of solar energy to electrical energy in photovoltaic cells. 4.5 State applications of various types of solar energy conversion techniques listed from 4.1 to 4.4. above.	Explain the conversion of solar energy to chemical energy in plants. List the applications of types of solar energy conversion techniques to; chemical energy, electrical energy (fuel cells),(photovoltaic cells)	- do -
12-13	**General Objectives**: 5.0 Understand the various methods of Storing Solar Energy.		
	Solar Energy Storage 5.1 Describe the following methods of storing solar energy mechanically: (i) Hydro-electric plants; (ii) Compressed gas energy storage; (iii) the flywheel. 5.2 Explain the procedure involved in thermal energy storage of solar energy. 5.3 Explain chemical energy storage in (i) Aqueous electrolyte batteries; (ii) Metal-air batteries; (iii) High temperature batteries; (iv) Organic electrolyte batteries.	Describe the various ways of storing solar energy mechanically. Explain chemical energy storage in 5.3. *Lecture *Give tutorials	- do -
14-15	**General Objectives:** 6.0 Understand specific applications of Solar Energy		
	Solar Energy Utilization 6.1 Explain the use of solar cells as power supply units. 6.2 Describe the construction of solar powered refrigerators ad air-conditioners. 6.3 Describe the solar production of: (i) Distilled water; (ii) Hydrogen	Discuss how solar cells can be used to generate power. Explain how to produce Distilled Water, hydrogen using solar energy.	- do -

WEEK	**General Objectives**:		
	Special Learning Objectives	**Teacher's Activities**	**Resources**
	6.4 Describe the construction of various farm produce storage devices using solar energy. 6.5 Describe the applications of solar energy for domestic use (e.g. solar house hybrid utilization.	*Lectures Discuss how solar energy can be applied to the construction of farm produce devices.	- do -

Programme: Physics with electronics.
Higher National Diploma

Course: PYE 417, Acoustics

Duration: 30 hours (2 hours lecture/week)

Unit: 2.0

Goal: This course is designed to provide with the knowledge of Acoutics

On completion of the course the students should be able to :

1.0 Understand the production, propagation and properties of sound energy
2.0 Understand the behaviour of sound waves in rooms and other enclosures
3.0 Understand the acoustics principles in musical instruments
4.0 Understand the acoustic principles in speech and hearing
5.0 Understand sound storage and reproduction
6.0 Understand the Production and applications of Ultrasonic waves

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Acoustics	**Course Code:** PYE 417	**Contact Hours:** Unit 2 CU 2	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the production, propagation and properties of sound energy.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-3	1.1 Outline the origin of sound energy as vibrating object. 1.2 Explain the propagation of sound through a medium 1.3 Explain the following terms in relation to sound wave propagation (i) pitch (ii) timbre (iii) quality. 1.4 Derive the sound energy equation. 1.5 Define (i) sound intensity (ii) bel (iii) decibel. 1.6 State the relationship between intensity and amplitude. 1.7 Explain the following properties of sound: (i) interference (ii) diffraction (iii) reflection (iv) refraction. 1.8 Differentiate between standing wave and traveling wave. 1.9 Define resonance. 1.10 Explain the concept of vibrating air-column in an enclosure. 1.11 Prove that fundamental frequency of an air-column increases with temperature.	Explain the concept of sound as a result of vibrating object. Discuss how sound travels in various mediums. Write out the derived sound energy equation. Relate intensity and amplitude of sound. Discuss these terms: Refraction, reflection, diffraction, and interference. Explain standing and traveling waves. Describe resonance and it's effect. Show mathematically the relationship between air-column and temperature	Textbooks

WEEK			
	General Objectives: 2.0 Understand the behavior of sound waves in rooms and other enclosures 3.1 Differentiate between noise and musical sound. 3.2 Define an octave	Distinguish between noise and sound. Explain what an octave	- do -
4-5	2.1 Explain the production of standing waves within enclosures. 3.3 Explain the three common musical scales (i) American standard scale A440; (ii) International pitch scale A435; (iii) the just scale (256) 2.2 Explain the concept of "dead zone" in halls and auditoria. 3.4 Derive expression for the fundamental frequency of sound obtainable from a tube, (of given diameter) (i) open at one end; (ii) open at both ends. 2.3 Explain the origin of reverberation in halls and auditoria. 2.4 Calculate the reverberation time using Sabine's formula. 3.5 Explain how the frequency of sound can be constructed along a given scale. 2.5 State the measures necessary for controlling reverberation in halls and auditoria. 3.6 Explain the principle of operation of wind instruments.	Discuss how standing waves are produced within enclosures. Explain the three common musical scales in 3.3 Describe "dead zones" Describe wind, string instruments and discuss their mode of operations. Explain how reverberation can be controlled.	Textbook
	General Objectives: 3.0 Understand the acoustics principles in musical instruments 3.7 Derive expression for the fundamental frequency of a vibrating string held at both ends.		
	3.8 Explain the principle of operation of stringed instruments. 3.9 Explain the operational principle of the following musical instruments (i) acoustic guitars (ii) flutes (iii) trumpets.		

WEEK	General Objectives: 4.0 Understand the acoustic principles in speech and hearing.		
	Special Learning Objectives	**Teacher's Activities**	**Resources**
9-10	**Physiological Acoustics** 4.1 Explain the production of sound by the human larynx, "sound box" 4.2 Explain the ability of the human being to alter the pitch of his voice. 4.3 Explain "coloration" by the mouth cavity. 4.4 Explain, with the aid of diagram, the essential features of the human ear. 4.5 Describe the process of human hearing. 4.6 List some peculiar characteristics of human hearing e.g. frequency limits, the increased sensitivity at higher frequencies for lower sounds.	Explain the concept in 4.2. Draw a human ear and indicate the important parts.	- do -

	Sound Storage and Reproduction 5.1 Describe how a microphone works. 5.2 Describe how an earphone works. 5.3 Describe the working principle of loudspeakers. 5.4 Explain the constructional features and uses of the following types of speakers: (i) tweeter, (ii) midrange, (iii) bass 5.5 Explain the principle of sound separation into different frequency ranges (tweeter, midrange, and bass) in a loudspeaker. 5.6 Explain, with the aid of diagram, the essential features of (i) mono recording (ii) stereo recording. 5.7 Describe the process of sound reproduction from a phonogram record with: (i) mono recording, (ii) stereo recording. 5.8 Explain the process of tape recording and reproduction.	Explain the operational principles of microphones and earphones. Explain how loudspeakers work. Discuss the separation principles in 5.6. Describe the process of tape recording and reproduction.	
	General Objectives: Understand sound storage and reproduction		

WEEK	**General Objectives**: 6.0 Understand the Production and applications of Ultrasonic waves		
	Special Learning Objectives	**Teacher's Activities**	**Resources**
14-15	6.1 Explain ultrasonic and infrasonic waves. 6.2 Describe the piezoelective and magnetostrictive. 6.3 Explain sonar and ultrasound	Explain the features of piezoelective and magnetostrictive generation of ultrasonic waves	- do -

Programme: Physics with electronics.
Higher National Diploma

Course: PYE 418, General Physics Practical II

Duration: 80 hours (lecture = 0 hour, Practicals = 6 hours, Tutorial = 0)

Unit: 2.0

Goal: This course is designed to enable students understand the operational principles of digital and analogue instruments and to determine the response of same physical quantities of simple control systems

On completion of the course the students should be able to :

1.0 Understand Principles of Operation of Analogue Instruments
2.0 Understand the Principle of Operation of Digital Instrument
3.0 Understand frequency response of simple control elements or systems
4.0 Understand the time response of simple control system
5.0 5.0 Understand interference Phenomenon

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: General Physics Practical II	**Course Code:** PYE 418	**Contact Hours: 6** Unit 2	
Course Specification: Practical Content			
WEEK	**General Objectives:** 1.0 Understand Principles of Operation of Analogue Instruments		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-3	1.1 Calibrate an ammeter using a potentiometer. 1.2 Calibrate a voltmeter using a potentiometer. 1.3 Calibrate a ballistic galvanometer using a standard capacitor. 1.4 Determine the sensitivity of a galvanometer 1.5 Determine the capacitance of a capacitor using a Q-meter 1.6 Determine the Inductance of an inductor using a Q-meter 1.7 Compare two nearly equal Resistances by the Carey – Foster Bridge. 1.8 Calibrate an X-Y/T recorder	Conduct practical demonstration in the use of Carey, Foster Bridge and X-Y/T Recorder	Ammeter, Potentiometer, Voltmeter, Ballistic Galvanometer, galvanometer Q-meter Q-meter
	General Objectives: 2.0 Understand the Principle of Operation of Digital Instrument		
	2.1 Calibrate a d.c voltmeter using digital voltmeter	Conducts an expit on the use of d.c and digital voltmeters	Digital voltmeter

WEEK	**General Objectives:** 3.0 Understand frequency response of simple control elements or systems		
	Special Learning Objectives	**Teacher's Activities**	**Resources**
	3.1 Determine the frequency response of a single – stage amplifier. 3.2 Determine the frequency response of a second order RC network. 3.3 Determine the frequency of the a.c mains using a sonometer	Conduct practical in frequency response in single stage, RC network, & a.c. mains	Oscilloscope Sonometer
	General Objectives: 4.0 Understand the time response of simple control system		
	4.1 Determine the time response of a first order RC-network 4.2 Determine the time response of a second order R L C network	Conduct practical on time response. Conduct practical on time response on R L C network	Oscilloscope Inductor Capacitor
	General Objectives: 5.0 Understand interference Phenomenon		
	5.1 Measure wavelength of light using Young double slit 5.2 Compare wavelengths using interferometer 5.3 Determine wavelength of light with grating. 5.4 Determine the wavelength of sodium light by Newton's Ring 5.5 Determine the wavelength of sodium light a Frenel's biprism 5.6 Determine the diameter of a fine wire by interference fringe measurement	Conducts a demonstration in the spectrometer, interferometer	Spectrometer Interferometer "

Programme: Physics with electronics.
Higher National Diploma

Course: PYE 421 Instrumentation II and control

Duration: 30 hours (lecture = 2 hours Practicals = 0 hour Tutorial = 0)

Unit: 2.0

Goal: This course is designed to provide students with an understanding of the applications of digital and analogue instruments and automatic control systems

On completion of the course the students should be able to :
1.0 Know the classification and general uses of analogue and digital Instruments
2.0 Understand the principle of operation and application of analogue (pointer) instruments
3.0 Understand the principle of operation and application of analogue (graphical) instruments
4.0 Understand the principle of operation and application of digital instruments
5.0 Understand the basic principles, classification and areas of application of automatic control systems.
6.0 Understand transfer function and frequency response of simple control elements or system
7.0 Understand the time response of simple control system

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Instrumentation II and Control	**Course Code:** PYE 421	**Contact Hours: 2** Unit 2	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Know the classification and general uses of analogue and digital Instruments		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-2	**Analogue and Digital Instruments** 1.1 Define (i) analogue instruments (ii) digital instruments. 1.2 Explain the classification of analogue instruments into: (i) Pointer – type (ii) graphical – type 1.3 Explain the sub-classification of analogue (pointer) instruments into:- (i) electromechanical instruments (ii) electric instruments. 1.4 List types of electromechanical instruments such as (i) moving coil instrument; (ii) moving iron instruments (ii) Electrodynamics instruments (iv) rectifier instruments (v) electrostatic instruments; (vi) energy meters. 1.5 Explain the general applications of each instruments listed in 1.4 above. 1.6 List types of electronic instruments such as: (i) d.c. Voltmeter; (ii) a.c. voltmeter; (iii) null detector (iii) "Q" meter (v) Hall effect devices. 1.7 Describe the general uses of each instrument listed in 1.6 above.	Explain the difference between analogue and analogue instruments. Group each type of instrument above and list out its applications. Discuss the uses of instruments in 1.6 Explain the concept of hall effect.	Textbook

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	1. 8 Classify analogue (graphical) instruments into:- (i) Moving coil recorders (ii) Potentiometer recorders; (ii) X-Y plotters (iv) UV recorders; C.R.O. 1.9 Explain methods of digital display such as: (i) Mechanical drum as disc. (ii) Neon tubes (iii) Incandescent display; (iv) Solid state (LED); (v) Liquid crystal	Explain why UV, potentiometer, moving coil recorders are grouped into analogue instrument. Demonstration	
3-4	**General Objectives:** 2.0 Understand the principle of operation and application of analogue (pointer) instruments		
	Analogue (Pointer) Instruments 2.1 Explain the principle of operation and construction of a moving coil instrument. 2.2 Describe the application of a moving coil instrument as; (i) A Galvanometer, (ii) An Ammeter (iii) A Voltmeter (iv) A Multimeter 2.3 Explain the principle of operation of a moving iron instrument. 2.4 Explain the application of a moving iron instrument as: (i) An Ammeter (ii) A Voltmeter (iii) A Power factor meter	Describe the mode of operation of a moving coil instrument. Relate the instrument above to ammeter, voltmeter, and multimeter. Relate moving iron instrument to 2.4 Demonstration Lecture	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	2.5 Explain the principle of operation of the electrodynamics instrument. 2.6 Explain the application of the electrodynamics instrument as: (i) An Ammeter (ii) A Voltmeter (iii) A Wattmeter (iv) A Power Factor Meter 2.7 Explain the principle of operation of the rectifier instruments. 2.8 Explain the application of the rectifier instruments as: (i) An Ammeter (ii) A Voltmeter (iii) A Multimeter 2.9 Explain the principle of operation of the null detector 2.10 Explain the application of the null-detector as a phase sensitive detector 2.11 Explain the principle of operation of the Q-meter 2.12 Explain the application of the Q-meter for the : (i) Determination of inductor properties (ii) Determination of capacitor properties	Discuss how electrodynamics, rectifier, null detector instruments and Q-meter work. List out their uses. Lecture Demonstration	

WEEK	**General Objectives:** 3.0 Understand the principle of operation and application of analogue (graphical) instruments		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
5-6	**Analogue (graphical) Instruments:** 3.1 Explain the principle of operation of the moving coil recorder. 3.2 State some specifications and application of the moving coil recorder. 3.3 Explain the principle of operation of the potentiometer recorder. 3.4 State some specifications and application of the Potentiometer recorder. 3.5 Explain the principle of operation of the X-Y plotter. 3.6 State some specifications of the X-Y plotter. 3.7 Explain the principle of operation of UV recorder. 3.8 State some specifications and application of the UV recorder. 3.9 Explain the principle of operation of a cathode ray oscilloscope. 3.10 State some specifications and application of the cathode ray oscilloscope.	Discuss the applications of Moving coil recorder, potentiometer recorder, X-Y plotter, UV recorder cathode ray oscilloscope..	
7-8	**General Objectives:** 4.0 Understand the principle of operation and application of digital instruments		
	Digital Instruments 4.1 Explain the construction and principle of operation of a digital counter. 4.2 State some specifications (features) of digital counter. 4.3 Explain the application of the digital counter for: (i) Frequency measurement (ii) Period Measurement (iii) Time Measurement (digital clock)	Demonstration Relate frequency, period and time measurements to digital counter mechanism.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	4.4 Explain the methods used for the conversion of an analogue to digital signal such as:- (i) Successive and Approximating Method (using ladder network). (ii) Ramp method or Voltage to Time Conservation Technique (iii) Voltage to Frequency Methods. 4.5 Explain the principle of operation of a digital voltmeter. 4.6 State some characteristics of digital voltmeter. 4.7 Explain the application of digital voltmeters for d.c. Voltage measurement.	Describe conversion of analogue system to digital system. Demonstration	
9-10	**General Objectives:** 5.0 Understand the basic principles, classification and areas of application of automatic control systems.		
	Concept of Automatic Control Systems 5.1 Explain the general concept and significance of control systems. 5.2 Classify control systems into types (i.e. open-loop) 5.3 State examples of op-loop and closed –loop control systems. 5.4 Explain, using the block diagramed, the following terms in relation to a closed –loop control system. (i) Reference signal (ii) Error signal (iii) Controlled Output signal (iv) Comparator (v) Control element etc.	Describe what control systems means in automation. With the aid of a diagram, relate the following to closed-loop control system: Controlled output signal, comparator, error signal, e t c.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	5.5 State the advantages and disadvantages of a closed-loop control system. 5.6 Explain, using simple block diagrammed, the principle of operation of : (i) Speed Control System (ii) Position Control System (iii) Process Control System	Itemize the merits and de-merits of closed-loop control. Discuss speed, position, and process control systems with the aid of a diagram. Demonstration	
	General Objectives: 6.0 Understand transfer function and frequency response of simple control elements or systems.		
	Transfer Function and Frequency Response 6.1 Define transfer function of a device or system. 6.2 Discuss the unit of dimension of transfer function. 6.3 Derive an expression for transfer function of: (i) Passive Electrical Networks (ii) Simple Operational Amplifier Circuits (iii) Pneumatic Flapper-Nozzle Arrangement; (iv) Simple Mechanical System 6.4 Derive expression for amplitude response, $A_{(w)}$ and phase response $Ø_{(w)}$ from known transfer function e.g. if $\frac{Vo}{V} = \frac{I}{1+ST} = \frac{\quad}{1+JWT}\ I$ Then $A(w) = \frac{I}{\sqrt{1+(WT)^2}}$ $Ø(w) = -\tan^{-1}(WT)$	Explain unit of dimension of transfer function.	

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	6.5 Explain the concept of the "decibel" in relation to amplitude response, i.e. $A(w) = 20 \log_{10} (\frac{Vo}{V1})$ dB 6.6 Plot the Bode diagrammed for simple expressions of transfer function, using the semi-log graph sheets	Demonstration Using examples	
	General Objectives: 7.0 Understand the time response of simple control system		
	7.1 State the tests signals normally employed in time response analysis, such as: (i) Step signal (ii) ramp signal etc. 7.2 Write expression in time and frequency domain to describe the test signals listed in 7.1 above. 7.3 Explain the general formula for the determination of time response as:: Vo(t) = L-1Vo (s) =L –1Vi (s), F (s) Where, V(i) (s) = Lap lace transform of input test signal F(s) = transfer function of any given device L-1 ie, the inverse Lap lace transform 7.4 Derive expression for time response of first-order system. 7.5 Derive expression for time response of second-order system 7.6 Define the parameters associated with the response of a second –order system i.e. overshoot, rise time etc.	Explain test signal in relation to: step signal, ramp signal. Solve simple mathematical problems involving time response.	

Programme: Physics with Electronics.
Higher National Diploma

Course: PYE 422 Microelectronic systems

Duration: 30 hours (lecture = 2 hours, Practicals = 0 hour, Tutorial = 0)

Unit: 2.0

Goal: This course is designed to provide students with an understanding of the structure, functionalism, and concept of micro processing system.

On completion of the course the students should be able to :

1.0 Understand the function of a CPU and its relation with other components of a Microprocessor System with respect to the address, data and control buses.
2.0 Understand the use of address selection and enabling signals within a microprocessor system
3.0 Understand the fetch executive sequence.
4.0 Identify the main classes of instruction within the instruction set of a microprocessor and understands their operations.
5.0 Trace the dynamic executive of a simple machine code programme
6.0 Understand the organization of the stock and its uses by sub routines
7.0 Understands the principles of interrupts
8.0 Appreciate classification and packaging of and technologies used in integrated circuits in microprocessor based system.
9.0 Appreciate classification and packaging of technologies used in integrated circuits in microprocessor
10.0 Understand bow board design system layout bus loading and distribution relate to signal degradation.
11.0 Solve practically the problem of signal degradation

	2.1 Explain the meaning of a tri-select/enable signal for control of the third states. 2.2 Explain that there is no logical conflict on the address bus since the microprocessor is the only talker. 2.3 Deduce that the microprocessor, RAM, ROM and input devices can all act as talkers on the common data bus without conflict by the use of tri-state devices. 2.4 Explain the process of address decoding and examines manufacturer's literature on commercial clips.	Lecture with examples Discuss the use of address selection in a microprocessor system. Explain the importance of address bus, control bus and date bus in a microprocessor system.	

PROGRAMME: ~~IIND PHYSICS WITH ELECTRONICS~~

Course: Microelectronic Systems	**Course Code:** PYE 422	**Contact Hours: 2** Unit 2.0

Course Specification:

WEEK	**General Objectives:** 1.0 Identifies and understands the function of a CPU and its relation with other components of a Microprocessor System with respect to the address, data and control buses.		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-2	1.1 Draw a microprocessor containing instruction register (IR) Programmed counted (PC) store address register, accumulator, arithmetic and logic unit (ALU), Status register, control and timing devices and explain the purpose of each. 1.2 Draw a block diagram of a typical microprocessor system including a microprocessor, memory (RAM and ROM), input/output, address bus, data bus, and control bus. 1.3 Explain the purpose of each component in 1.2 and the need for both RAM and ROM in a system. 1.4 Draw a typical memory map for a small system.	Lecture with examples Explain the internal structure of a microprocessor. Explain the function of each unit of a microprocessor system. State the application of microprocessor in practical systems. Solve problems on microprocessor system. - do -	
3-4	**General Objectives:** 2.0 Understand the use of address selection and enabling signals within a microprocessor system		

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	2.5 Explain how part of the control bus (e.g. clock, read, write e.t.c) are used to control the data transfers. 2.6 Analysis schematic diagrams showing the interconnection of processing, memory and 1/10 ports using data address, read/write-enabling signals. 2.7 Examiners the relationship between the signals in 2.6 using a CRO or logic analyzer.	- do -	
5-6	**General Objectives:** 3.0 Understand the fetch executive sequence.		
	3.1 Explain the basic operation as fetching the instruction to the microprocessor, decoding the instruction within the microprocessor, fetching more data required and executing the instruction. 3.2 Illustrates the fetch execute sequence for a simple data transfer instruction involving the accumulator and memory on 1/0 port. 3.3 Illustrates the execute sequence for a simple jump instruction. 3.4 Interpret timing diagrams to show the relationship between clock pulses and bus signals for the transfer defined in 3.2	Lecture with examples Explain the fletch cycle in a microprocessor. Give examples to students to illustrate the fletch execute cycle (sequence) Explain with the aid of suitable diagrams the synchronization of bus microprocessor system.	
7	**General Objectives:** 4.0 Identifies the main classes of instruction within the instruction set of a microprocessor and understands their operations.		
	4.1 Give examples from main types of instruction groups: data transfer instructions memory reference and 1/0, arithmetic and logic instructions test and branch instructions. 4.2 Explain the use of four addressing modes and differentials between them.	Lecture with examples. Discuss the types of instruction set. Describe the features of the addressing modes in 4.2.	

WEEK	**General Objectives:** 5.0 Traces the dynamic executive of a simple machine code programme		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
8-9	5.1 Explains that, for any given problem, a set of steps called an algorithm must be created which will solve the problem. 5.2 Define the algorithm (draws the programs to solve a given sample problem. 5.3 Defines that in order to load and executive a simple program. Some software must already exist within the machine. 5.4 Constructs trace tables of the problem in 5.2 5.5 Vilifies the trace table in 5.4 by loading and single. 5.6 Examine the bus signals under clock control during the execution of programs in 5.2	Lecture with examples Give assignment. Give examples of algorithm. Explain the importance of flow chart in writing programs. Give assignment on trace tables. Illustrate with suitable timing diagram the variation of bus signals under clock control during the execution of programs.	
9	**General Objectives:** 6.0 Understand the organization of the stock and its uses by sub routines		
	6.1 Explain the medianism of the stock as a last in first out (LIFO) store and the function of the stack pointer in this operation. 6.2 Explain the use of the stack in the storing of the return address from sub routine of a sub routine, saving of MPU resister contents. 6.3 Shows how the sack can be used to pass parameters between the main program and a sub routine. 6.4 test sub routine for: timing delay, a defined mathematical function, an input or output routine.	Lecture with worked examples Explain the working principles of stack memory. Solve problems in involving stack memory.	

WEEK	**General Objectives:** 7.0 Understand the principles of interrupts		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
10-11	7.1 Deduces why interrupts are necessary especially in the handling of data transfer between peripheral and computer. 7.2 Explains that an interrupt may cause the main program to call an interrupt servicing an interrupt. 7.3 Infers that in returning from the ISR, the main program should continue as thought it had never been interrupted. 7.4 Explain the use of the sack in saving and restoring MPU registers when servicing an interrupt. 7.5 Explain the mechanism of the microprocessor response upon receipt of an interrupt. 7.6 Distinguishes between mask able and non-mask able interrupts.	Explain the principle of interrupt in data transfer. Explain the relationship between MPU registers, stack and interrupt. State the types of interrupts and their applications	
	General Objectives: 8.0 Appreciate classification and packaging of and technologies used in integrated circuits in microprocessor based system.		
	8.1 Identifies, using manufacturer's literature the characteristics of a single chip computing element e.g. 8 bit and 16 bit processors and bit slice elements. 8.2 Discusses, using manufacturer's literature, the function, operation and distinguishing characteristics of: Static RAM, dynamic RAM, MOS, EPROM, EEROM, parallel output port. 8.3 Investigates practically the performance of these devices with reference to manufacturer's data sheets and the system design.	Explain characteristics function and operation of items in 8.1 and 8.2 using manufacturers literature. Discuss the performance of items listed above.	

WEEK	**General Objectives:** 9.0 Use a microcomputer system to write, assemble, run and Debug program		
13	**Special Learning Objectives:**	**Teachers Activities**	**Resources**
	9.1 Write programs involving assignment, selection and iteration. 9.2 Assembles, debugs and executes the programs written in 9.1 9.3 Writes, assembles, tests and debugs an assembly language program to: parallel ports, ser4ial ports involving the use of sub routines and interrupts	Illustrate with examples Guide the students to write, debug and create programs in assembly language.	
14	**General Objectives:** 10.0 Understand bow board design system layout bus loading and distribution relate to signal degradation		
	10.1 Relates logic circuit diagrams to printed circuit board (P.C.B) layout. 10.2 Explain the effect inductance, capacitance and resistance associated with P.C.B's on high-speed digital signal.	Explain the sources of digital signal degradation in printed circuit board.	
	General Objectives: 11.0 Solve practically the problem of signal degradation		
	11.1 Uses buffer elements to prevent ringing in bus lines. 11.2 Uses decoupling networks to eliminate cross talk	Solve problems on signal degradation in PCB.	

Programme: Physics with electronics.
Higher National Diploma

Course: PYE 423 Equipment Reliability.

Duration: 30 hours (lecture = 2 hours, Practicals = 0 hour, Tutorial = 0)

Unit: 2.0

Goal: This course is designed to enable students know the basic concepts of reliability engineering and it's importance in electronics equipment and systems

On completion of the course the students should be able to :
1.0 Understand the basic terms and relationships commonly used in reliability
2.0 Understand the Concept of Reliability Prediction
3.0 Understand the causes and remedies of component failure
4.0 Understand the basic principle of maintainability
5.0 Understand specifications and its importance

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: Equipment Reliability	**Course Code:** PYE 423	**Contact Hours: 2** Unit 2.0	
Course Specification: Theoretical Content			
WEEK	**General Objectives:** 1.0 Understand the basic terms and relationships commonly used in reliability		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
1-4	1.1 Explain the importance of reliability with respect to electronic equipment and systems. 1.2 Define the terms: (i) Reliability (ii) Failure (iii) Item (iv) Mean time between failure (MTBF) (v) Mean time to failure (MTTF). 1.3 Explain the meaning of the following types of failure (i) Misuse failure (ii) Inherent weakness failure (iii) Sudden failure (iv) gradual failure (v) Partial failure (iv) Catastrophic failure and (vii) degradation failure. 1.4 Differentiate between instantaneous and proportional failure rates. 1.5 State the relationship between failure rate (λ) and MTBF, i.e, MTBF = i/λ , where MTBF is mean time between failures. 1.6 Explain the reliability equations and related curves when λ is constant, ie, $R = e^{-\lambda t}$ $Q = I - e^{-\lambda t}$ $R + Q = 1$ Where R is reliability (ie probability of no failure in time, t); Q is unreliability t is time. 1.7 Explain a properly labelled Bath – tub diagram (a graph of failure rate against time).	Lecture with worked examples Explain the terms in 1.2. Discuss the meaning of (i) failure (ii) misuse failure (iii) inherent weakness failure e.t.c. Explain the difference between instantaneous and proportional failures. Write down reliability equations in 1.6 Solve some simple problems on reliability of equipments	Textbooks

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	1.8State the probable causes of failure in each of the regions of the Bath – tub diagram. 1.9Explain the wear out failure versus time curve and the parameters obtainable therefore such as: (i) Mean (wear out) life; (ii) Standard deviation of the wear-out life; (iii) Estimates of confidence limits. 1.10 Compute the mean wear- out life of electronic items using a normal (Gaussian) distribution curve. 1.11 Determine the failure rate for a unit, from the failure rates of its constituent parts using the relationship; overall failure rate = basic failure x no of similar parts x weighting factor (environmental) x weighting factor (rating) x weighting factor (temperature), i.e, $\lambda_T = \lambda$xn x we x wr x wt	Lecture. Explain wear-out life of equipments. Discuss failure rate and it's relation to basic failure, weighting factors(rating, environmental, temperature e t c.	Textbooks
5-7	**General Objectives:** 2.0 Understand the Concept of Reliability Prediction		
	2.1 Explain the basic probability rules (ie, multiplication and addition rules and the binomial probability theorem in relation to reliability calculations. 2.2 Write expression for the reliability and MTBF of items connected in series. 2.3 Write expression for the reliability and MTBF of items connected in parallel. 2.4 Determine the reliability and MTBF of series and parallel items. 2.5 Explain the meaning and significance of redundancy.	Lecture. Discuss the basic rules of probability.	Textbooks

WEEK	General Objectives:		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
	2.6 Differentiate between active and passive (standby) redundancy. 2.7 State some limitations in applying redundancy as a means of improving reliability. 2.8 State practical applications of active and standby redundancy. 2.9 Solve problems on active and passive redundancy.	Explain what is meant by passive and active redundancy. Lecture with worked examples	Textbooks
8-10	**General Objectives:** 3.0 Understand the causes and remedies of component failure		
	3.1 Explain the causes of failure due to environmental factors, (i.e. effect of temperature, humidity, atmospheric pressure, dust, chemical content and radiation). 3.2 Explain other causes of component failure due to mechanical stresses, such as shock, vibration and friction. 3.3 Explain the causes of component failure due to operating stress, (i.e., effect of operating voltage, current and frequency. 3.4 State specific methods of dealing with environmental and mechanical problems. 3.5 Explain "Derating" as a method of dealing with failure problems caused by operational stresses. 3.6 Illustrate "Derating" by applying the Archeries law (the fifth power law)	Discuss into details the cause of component failure. List methods of solving failure due to mechanical and environmental factors	Textbook

WEEK	**General Objectives:** 4.0 Understand the basic principle of maintainability		
	Special Learning Objectives:	**Teachers Activities**	**Resources**
11-13	4.1 Define the term "maintainability. 4.2 Explain the importance of maintainability in relation to reliability 4.3 State the factors affecting maintainability. 4.4 Explain the methods of improving maintainability. 4.5 Explain the following terms:- (i) Utilization factor (ii) Availability (iii) Unavailability (iv) Repraisability 4.6 Explain the concept of preventive and corrective maintenance. 4.7 Explain, with the aid of sketches, the relationship between cost and equipment reliability. 4.8 Explain the need for failure reporting.	Discuss how maintenance is important and relate it to reliability. List out the methods of improving maintainability. Explain the importance of corrective and preventive maintenance Discuss the relevance of failure reporting.	Textbooks
14-15	**General Objectives:** 5.0 Understand specifications and its importance		
	5.1 Define the term "specifications". 5.2 State the aims and uses of specifications. 5.3 List typical items of information that should be included in specifications. 5.4 Illustrate 5.3 with examples of specifications for typical measuring/test equipment.	Explain the importance and uses of "specifications" Lecture.	Textbook

Programme: Physics with electronics.
Higher National Diploma

Course: PYE 424 Electronics practicals II

Duration: 80 hours (lecture = 0 hours, Practicals = 6 hours, Tutorial = 0)

Unit: 2.0

Goal This course is designed to provide students with an understanding of the applications of analogue and digital instruments and variables of automatic control systems.

On completion of the course the students should be able to :
1.0 Understand the principles of operations of analogue instruments
2.0 Understand the principles of operations of digital instruments
3.0 Understand frequency response of simple control elements or systems
4.0 Understand the time response of simple control systems
5.0 Understand interference phenomenon

PROGRAMME: HND PHYSICS WITH ELECTRONICS			
Course: General Physics II Course Code: PYE 424 Contact Hours 6 Units 2			
Course Specification: PRACTICAL CONTENT			
Week	General Objectives: Understand principles of operation of Analogue instruments		
	Special Learning Objectives:	Teachers Activities	Resources
	1.10 Calibrate on ammeter using a potentiometer 1.11 Calibrate a voltmeter using a potentiometer 1.12 Calibrate a ballistic galvanometer using a standard capacitor 1.13 Determine the sensitivity of a galvanometer 1.14 Determine the capacitance of a capacitor using a Q-meter 1.15 Determine the inductance of an inductor using a Q-meter 1.16 Compare two nearly equal resistances by the carey-foster Bridge 1.17 Calibrate an X-Y/T recorder	Laboratory practise calibration of ammeter, voltmeter and potentiometer Conduct practical demonstration in the use of carey-foster Bridge and X-Y/T recorder	Ammeter, potentiometer, voltmeter, potentiometer Balistic galvanometer Galvanometer Q-meter Carey-foster Bridge X-Y/T recorder
	General Objectives: 2.0 Understand the principle of operation of digital instrument		
	2.1 Calibrate a d.c. voltmeter using digital voltmeter	Conduct the use of digital voltmeter	Digital voltmeter

General Objectives: 3.0 Understand frequency response of simple control elements or systems			
	3.1 Determine the frequency response of a single-stage amplifier 3.2 Determine the frequency response of a second-order RC-network 3.3 Determine the frequency of the a.c mains using a sonometer	Conduct practical in frequency response, in single- stage, RC network and a.c mains	Oscilloscope Sonometer
	General Objectives: 4.0 Understand the time response of simple control system		
	4.1 Determine the time response of a first-order RC-network 4.2 Determine the time response of a second-order RLC network	Conduct practical in time response Conduct practical in time response in RLC network	Oscilloscope Inductor Capacitor
	General Objectives: 5.0 Understand interference phenomenon		
	5.1 measure wavelength of light using Young double slit. 5.2 Compare wavelengths using interferometer 5.3 Determine wavelength of light with grating 5.4 Determine the wavelength of sodium light by Neuton's Ring 5.5 Determine the wavelength of sodium light using a fresnels biprism 5.6 Determine the diameter of a gfine wire by interference fringe measurement	Conduct a demonstration in the use of pectometer inter sonometer	Spectrometer Interformeter Spectrometer

LIST OF EQUIPMENT

S/No	Item	Quality	Remarks
1.	Air Cell (critical angle) complete with mounting and scale	5	
2.	Air thermometer, constant volume with mercury	2	
3	Beam balance, 250g x 2mg with case and weighs	5	
4	Analogue half life apparatus	1	
5	Ball bearings, 10mm diameter, pack of ten	10pks	
6	Barometer, Portia's, with scale graduated 26 to 32 inch x 0.05mm.		
	Bob, Pendulum, 13mm diameter, brass	1	
7	Boyle's law apparatus: "J" tube type, mounted	12	
8	Brass spheres, 25mm diameter, inculcated, pair on rods		
9	Bungs, rubbers, 25mm diameter, solid, 1 hole and 2 holes; set of 57	1	
10	Capacitance substitution box, 11 preferred values (variable)		
	Cell: Daniell's Nickel-caldarium, alcod, 23 ampler	4sets	
	Solid eletrolyte for alcad cells can of 500g	10	
11	Hydrometer for alcad cells	5 1 cab	
12	Cell, standard, miniature	2	
13	Crocodile clips, pack of 10 coil board, (field at center of circular coil	5	
14	apparatus)	5	
15	Commulator (plug pattern)		
16	Compass	4pks	
17	Continuous flow apparatus, for specific heat capacity	2	
18	Diffraction grating, slide	10pks	
19	Discharge tube: geissler's tube argon filled	2	
20	Discharge tube: geissler's tube neon filled	1	
21	Discharge tube: geissler's tube hydrogen filled	1	
22	Earphones, 2000 ohms, total impedence (pair)	1	

	Electromagnet	1	
23	Horse-shoe magnet	30	
24	Electroscope gold leaf simple form	4	
25	Light filters: 50mm square, deep red (primary	4	
26	50mm square, deep blue (primary)	2	
27	50mm square, deep green (primary)	1	
	Forces board, wall type plus cords and loads	1	
	Pulley with clamp for above.	1	
28	Galvanometer: Centre zero,3.5mA-0-3.5mA, resistance 10ohms	5	
29	Gauze iron, with ceramic center	5sets	
30	Inclined plane and friction board.	10	
31	Induction: large air-cored of different inductance values	24	
32	Induction coil, 6mm spark	6	
33	Interference and diffraction stand, universal	10	
34	Joulemeter, digital, electronic	1	
35	Key, reversing and tappling	1	
36	Kundt’s tube unmounted plus wooden stand	1	
37	Stand, lamphouse and transformers with sodium lamp and mercury lamp	10	
38	Latent heat of steam apparatus	2	
39	Less” disc apparatus		
	Lens, condenser, plane-convex, d=100mm, f=150mm	2	
40	Lens, spherical, biconves-diameter 50mm	3	
41	Focal length, 500mm	3	
42	Focal length, 250mm	2	
43	Focal length, 200mm	2	
	Focal length, 150mm	4	
	Focal length 100mm	2	
	Linear expansion apparatus	2	
	Loudspeaker, pair	2	
	Millikan apparatus	2	
44	Micrometer screw guage	4pairs	

45	Microphones in use with C.R.O., etc	1	
46	Microscope slides, box of 100	2	
47	Mirror, plane, 75mm x 25mm, mounted plane 75mm x 75mm mounted	6	
48	spherical, concave, 50mm diameter focal length, 200mm	20	
49	Focal length, 150mm	2	
50	Focal length, 100mm		
	Spherical, convex, 50mm diameter		
	Focal length,200mm	6	
	Focal length, 150mm	12	
	Focal length, 100mm	6	
	Multimeter, d.c 100mV-200V (9 ranges)		
	Optical bench	6	
	Photocell mounted	6	
	Oscillator sine and square signal generator	6	
51	Oscilloscope, single beam	2	
52	Double beam	12	
53	Parallel plate air capacitor with dielectric sheet	2	
54	Pendulum, compound	2	
55	Plasticine, pack of 500g	5	
	Polar meter	2	
56	Potentiometer, 1 meter, single wire	2sets	
57	Power supply unit, general purpose with meter, 0-30V or 0-60V	5	
58	Prism, Perspex: 60: 60: 63mm edges	1	
59	Right angle hypotenuse 100mm	2	
60	(i) 45; 45o	10	
61	(ii) 30; 60o	5	
62	Projectile apparatus	12	
	Radio-active sources: radium-226 (alpha, beta, gamma)		
	Ray box complete with lamp and triple slit	12	
	Resistance: box 0-999.9 ohms x 0.1 ohm “known” 1 ohm	12	
63	“ 2 “		

64	“ 5	1	
65	“ 10 “	6	
66	“ 4.5 ohms	12	
	“ 1.4 @	6	
	Resonance tube apparatus	6	
	Revolution counter	6	
	Rheostat: 11.6 ohms, 4A	6	
	15.7 “ 4A	6	
67	21.0 “ 2A	6	
68	195. ohms, approx., 1A	1	
69	330 “ approx. 1.2A	1	
	Ripple tank kit and accessories	6	
	Illuminant	6	
	Power supply unit	6	
	Stroboscope, motorized	6	
70	Rods; pessper, polythene	6	
	Rods, steel (mild) 200 x 12mm diameter pack of 10	2	
	Rotary tube and solenoid for hysterics experiment,	2	
	Complete with specimen of mild steel and silver steel	2	
	Search coil, for use with “edsport” galvanometer	12each	
71	Smoke cell, for Brownian movement in smoke cell	1	
72	Microscope, for observing Borownian in smoke cell	1	
73	Solenoid, demonstration	2	
74	Sonometer, 2 wire pattern	1	
75	Spectrometer, reading to 1 minute of or 6	2	
76	Spherometer	2	
77	Plug (black); 4mm, red 4mm	2	
78	Retort stands with clamps and bosses	3	
79	Stopclock, dial 140mm diameter	2	
80	Surface tension apparatus (Searle’s)	6	
81	Switch, plug pattern, 1 way	30	

82	Switch knife (two way)	30	
83	Thermocouple, copper – constantan, single	4	
84	Thermometer 10 to + 110oC x 1oC	4	
85	- 5 to + 50oC x 0.1oc	15	
85	- 10 to + 360oC x 20oC	15	
87	- 10 to + 105oC x 2oC	5	
88	Thermopile, copper-constantan	24	
	Transformers, general purpose, 2, 4, 6, 8, and 12V	6	
	Tuning forks, (set of 13)	4	
	Millimeters 0 – 2mA	12	
89	0 – 5mA	4	
90	0 – 10mA	6	
91	0 - 50mA	1 sets	
92	0 - 100mA	5	
	Multivoltmeter, double range: 0-10mV and 0-100mV d.c	5	
	Universal indicator, moving coil 15ml d.c	5	
	Shunt carrier for above	5	
	150mA d.c shunt for above	5	
93	600mA d.c shunt for above	2each	
94	1.5A d.c shunt for above	10	
	Value, double diode	10	
	Vernier calipers	10	
	Viscometer, Ostwald’s	10	
	2 weights x 0.5kg and 1 each 1,2,5 and 10kg, total	2	
95	Wheatstone bridger, 1 metre	12	
96	Wire: connecting bamp, p.v.c multistsand copper, red	2	
97	Constantan, insulated, 26 s.w.g. 125g reel;	2 sets	
98	Constantan, insulated, 28 s.w.g. 125h reel	6	
99	Constantan, insulated 30 s.w.g. 125g reel;	50m	
100	Constantan insulated 32 s.w.g. 125g reel;	50m	
	Constantan, insulated 34 s.w.g. 125g reel;		

	Constantan, bare 24 s.w.g. 125 reel		
	Constantan, bare 26 s.w.g. 125 reel		
	Copper, double sayon covered, 22 s.w.g. 250g reel		
	Iron 34 s.w.g		
	Nichrome, bare 24 s.w.g. 125g reel		
	Nichrome, bare 26 s.e.g 125g reel		
	7400 TTL logic gates series)		
	7401)		
	4000 CMOS series		
	G.M tube and holder		
101	Rate meter		
	Youngs nodulus apparatus, rernier plus wires	5 each	
	Youngs slits, class kit of 4 suling devices, etc		
102	Breadboards	1	
103	Vero boards	1	
104	Diodes (germanium silicon, general purpose zener,	4	
105	Tunnel	2kits	
106	Transistors (different types BJT, FET, UJT)	5	
107	Photo transistor	40	
108	Thermistor	8 each	
	Cadmium salphide cell		
109	Solar cell	20	
110	Reistors of different values, rating and types	10	
111	555 IC times	10	
112	556 IC time	5	
113		5	
114	Rectifier unit (IC)	9 sets each	
115	7 – pin IC socket)	9 each	
116	14 – pin IC socket)	10	
	16 – pin IC socket)		
118	24 – pin IC =		

119	Capacitors (different types 1 uf etc) ceramic, paper electrolytic tantamium, variable		
	Tools:		
120	Soldering iron (different power satings 15w, 25W, 40W and 60W	20 each	
	Solder sucker	30	
	Long nose plier		
	Diagonal slide cutter		
121	Flat spanners		
	Set trim tools	10	
122	Set box spanners	10	
123	Tool box	10	
124	Overhead projector	10	
125	Wire stripper	10	
126		1 sets	
127	**Glass Ware**	2	
128	Beakers squat graduated pyrex 100cm3	2	
129	250cm3	1	
130	600cm3	2	
	1000cm3		
	50cm3		
131	Cylinder, measuring: 100cm3	1 pk	
	250cm3	1 pk	
	1000cm3	1 pk	
	50cm3	1pk	
	Conical flasks 250cm3 pyrex	10	
132	Density bottle 50cm3	10	
	Test tube 125 x 16mm pyrex	10	
	Test tube boiling tube, 150mm x 24mm x 24 pryex	10	
	Glass troughs	10	
133	Tubing glass (1) 6mm external diameter, 1.5 meter length	20	

134	(2) 8mm external diameter, 1.5 meter length	50	
135	(3) Capillary, 1mm bore	20	
136	U-tube height 20cm, diameter 1.9cm	3	
137	Block glass, “rectangular” 115 x 65 x 2cm	10	
138	Perspex, semicircular 90 x 45 16m		
	Store	10 ength	
	Technologists office		
		6“	
139	**INSTRUMENTATION ROOM**	12	
140	Measuring Instruments	12	
141	Moving coil	12	
142	Moving iron	1	
143	Thermocouple	1	
	Oscilloscope		
	Signal generators		
1	Pressure measuring Instruments	2	
	Barometers	2	
	Manometers	2	
	Pressure gauges	2	
	Spectrophotometer	2	
	Colorimeter	2	
	Flame photmeter		
	Ramain Spectrophotometer	2	
	Atomic absorption spectrophotometer	2	
	X-ray spectroscope	2	
2	Electrolytic conductivity bridge	1 each	
3	Coulometric titrator	1	
4	PH meter	1	
5	Autotitrator	1	
6	Polarograph	1	
7	Radio active detector	1	

8	Fluorimeter	1	
9	Polarimeter	1	
10	Refractometer	2	
11	Autoradiograph	1	
12	Voltameter	1	
13	Ammeter	1	
14	Resistors	1	
15	Conductivity meter	1	
16	Ion-selecture electrodes	1	
17	Ion-exchange electrodes	5	
18	Microscopes	5	
19	Autodiography	2 each	
20	Camera lucida	1	
21	Centrifuge	2	
22	Melting point apparatus	2	
23	Gas/Liquid Chromatography	10	
24	Liquid/Liquid Chromatrograph	1	
5	Column Chromatography	1	
26	Rotary Evaporator	2	
27	Computer System with Printer		

LIST OF PARTICIPANTS

1)	Dr. M. N. Umego	-	Chairman	Physics Dept, ABU, Zaria
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