USE OF ENGLISH

1. GENERAL OBJECTIVES

The aim of the Unified Tertiary Matriculation Examination (UTME) syllabus in Use of English is to guide candidates in their preparation for the Board's examination. It is designed to evaluate the candidates' ability to:

(i) communicate effectively in both written and spoken English; and
(ii) use English Language for learning at the tertiary level.

2. The syllabus consists of three sections:

SECTION A: Comprehension and Summary
SECTION B: Lexis and Structure
SECTION C: Oral Forms

3. DETAILED SYLLABUS/CONTENTS

TOPICS/CONTENTS/NOTES	OBJECTIVES
A. Comprehension and Summary (a) description (b) narration (c) exposition (d) argumentation/persuasion (i) Each of the three passages to be set (one will be a cloze test) should reflect various disciplines and be about 200 words long. (ii) Questions on the passages will test the following: (a) Comprehension of the whole or part of each passage. (b) Comprehension of words, phrases, clauses, sentences, figures of speech and idioms as used in the passages. (c) Coherence and logical reasoning (deductions, inferences, etc). (d) Approved Reading Text (*The Life Changer* by Khadija Abubakar Jalli). (e) Synthesis of ideas from the passages.	Candidates should be able to: i. identify main points/topic sentences in passages; ii. determine implied meanings; iii. identify the grammatical functions of words, phrases, clauses and figurative /idiomatic expressions; and iv. deduce or infer the writers' intentions including mood, attitude to the subject matter and opinion.

TOPICS/CONTENTS/NOTES	**OBJECTIVES**
NOTE: Synthesis of ideas means the art of combining distinct or separate pieces of information to form a complete whole as summary.	
B. Lexis and Structure (a) synonyms (b) antonyms (c) clause and sentence patterns (d) word classes and their functions (e) mood, tense, aspect, number, agreement/concord, degree (positive, comparative and superlative) and question tags (f) mechanics (g) ordinary usage, figurative usage and idiomatic usage. **NOTE**: Idioms to be tested are those that are formal and expressed in Standard British English. (SBE).	Candidates should be able to: i. identify words and expressions in their ordinary, figurative and idiomatic contexts; ii. determine similar and opposite meanings of words; iii. differentiate between correct and incorrect spellings; iv. identify various grammatical patterns in use; and v. interpret information conveyed in sentences.
C. Oral Forms (a) Vowels (monothongs, diphthongs and triphthongs) (b) Consonants (including clusters) (c) Rhymes (including homophones) (d) Word stress (monosyllabic and polysyllabic) (e) Emphatic stress (in connected speech) **NOTE:** Emphatic stress involves the placement of stress on words in an utterance for the purpose of emphasis.	Candidates should be able to: i. make distinctions among vowel types; ii. differentiate among consonant types; and iii. identify correct pronunciation of individual words and articulation of connected speech.

D. THE STRUCTURE OF THE EXAMINATION

SECTION A: **Comprehension and Summary**

(a)	1 comprehension passage -	5 questions
(b)	1 cloze passage -	10 questions
(c)	1 reading text -	10 questions

SECTION B: **Lexis and Structure**

(a)	Sentence interpretation -	5 questions
(b)	Antonyms -	5 questions
(c)	Synonyms -	5questions
(d)	Basic Grammar -	10 questions

SECTION C: **Oral Forms**

a)	Vowels -	2 questions
b)	Consonants -	2 questions
c)	Rhymes -	2 questions
d)	Word Stress -	2 questions
e)	Emphatic Stress -	2 questions

Total: 60 questions

RECOMMENDED TEXTS

Adedimeji, M. A (2021) Doses of Grammar. Patigi. Ahman Pategi University Press.

Attah, M. O. (2013). *Practice in Spoken English for Intermediate and Advanced Learners*. Maiduguri: University of Maiduguri Press.

Bamgbose, A. (2002). *English Lexis and Structure for Senior Secondary Schools and Colleges (Revised Edition)*. Ibadan: Heinemann.

Banjo, A., Adeniran A., Akano, A. and Onoga, U. (2004) New Oxford Secondary English Course Book six for Senior Secondary Schools. Ibadan: University Press Plc.

Caesar, O. J. (2003). *Essential Oral English for Schools and Colleges*. Lagos: Tonad Publishers Limited.

Jones, D. (2011). *Cambridge English Pronouncing Dictionary*. Cambridge: Cambridge University Press.

Egbe, D. I (1996). *Mastering English Usage and Communication Skills*. Lagos: Tisons.

Elugbe, B. (2000). *Oral English for Schools and Colleges*. Ibadan: Heinemann.

Grant, N. J. H., Nnamonu, S. and Jowitt, D. (1998) *Senior English Project 3. (New Edition)* Harlow: Longman.

Idowu., O. O., Sogbesan, T. S., Adofo, A. K., Burgess, D. F. and Burgess, L. J. (1998) *Round-up English: A Complete Guide,* Lagos: Longman.

Idris, U. (2001). *Oral English at Your Fingertips for Schools and Colleges*. Lagos: M. Youngbrain Publishers.

Igiligi, E. C. and Ogenyi, S. O. (2010) *Grammar and Composition in the G.S.M. Age.* Enugu: Joe Hills Production Services.

Jauro, L. B. (2013). *Oral English for Schools and Colleges: A Teaching and Learning Approach.* Yola: Paraclete Publishers.

Nnamonu, S. and Jowitt, D. (1989) *Common Errors in English.* Lagos: Longman.

Obinna, M. F. (2001) *University Matriculation Use of English. (Fourth Edition).* Port Harcourt: Sunray Books Limited.

Ogunsanwo, O., Duruaku, A. B.C., Ezechukwu, J. and Nwachukwu, U. I. (2005) *Countdown English Language (Revised Edition).* Ibadan: Evans Brothers.

Olatoye, S. (2006) *The Silent Teacher.* Ado-Ekiti: Segun and Sons Enterprises.

Oluikpe, B. O. A., Nnaemeka, B. A., Obah, T. Y., Otagburuagu, E. J., Onuigbo, S. and Ogbonna, E. A. (1998) *Intensive English for Senior Secondary School 3*. Onitsha: Africana. First Publishers.

Tomori, S. H. O. (2000) *Objective Tests for School Certificate English: Practice in Lexis, Structure and Idiom (Reprinted Edition)*. Ibadan: Heinemann.

Ukwuegbu, C., Okoro, O., Idris, A. U., Okebukola, F. O. and Owokade, C. O. (2002) *Catch-up English for SSCE/UME.* Ibadan: Heinemann.

PHYSICS

GENERAL OBJECTIVES

The aim of the Unified Tertiary Matriculation Examination (UTME) syllabus in Physics is to prepare the candidates for the Board's examination. It is designed to test their achievement of the course objectives, which are to:

(1) sustain their interest in physics;

(2) develop attitude relevant to physics that encourage accuracy, precision and objectivity;

(3) interpret physical phenomena, laws, definitions, concepts and other theories;

(4) demonstrate the ability to solve correctly physics problems using relevant theories and concepts.

DETAILED SYLLABUS

TOPICS/CONTENTS/NOTES	OBJECTIVES
1. MEASUREMENTS AND UNITS (a) Length, area and volume: Metre rule, Venier calipers, Micrometer Screw-guage, measuring cylinder. **(b) Mass** (i) unit of mass; (ii) use of simple beam balance; (iii) concept of beam balance. **(c) Time** (i) unit of time; (ii) time-measuring devices. **(d) Fundamental physical quantities**	Candidates should be able to: i. identify the units of length, area and volume; ii. use different measuring instruments; iii. determine the lengths, surface areas and volume of regular and irregular bodies; iv. identify the unit of mass; v. use simple beam balance, e.g Buchart's balance and chemical balance; vi. identify the unit of time; vii. use different time-measuring devices; viii. relate the fundamental physical quantities to their units;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(e) Derived physical quantities and their units (i) Combinations of fundamental quantities and determination of their units; **(f) Dimensions** (i) definition of dimensions (ii) simple examples **(g) Limitations of experimental measurements** (i) accuracy of measuring instruments; (ii) simple estimation of errors; (iii) significant figures; (iv) standard form. **(h) Measurement, position, distance and displacement** (i) concept of displacement; (ii) distinction between distance and displacement; (iii) concept of position and coordinates; (iv) frame of reference. **2. Scalars and Vectors** (i) definition of scalar and vector quantities; (ii) examples of scalar and vector quantities; (iii) relative velocity; (iv) resolution of vectors into two perpendicular directions including graphical methods of solution.	ix. deduce the units of derived physical quantities; x. determine the dimensions of physical quantities; xi. use the dimensions to determine the units of physical quantities; xii. test the homogeneity of an equation; xiii. determine the accuracy of measuring instruments; xiv. estimate simple errors; xv. express measurements in standard form. Candidates should be able to: i. use strings, meter ruler and engineering calipers, vernier calipers and micrometer, screw guage; ii. note the degree of accuracy; iii. identify distance travel in a specified direction; iv. use compass and protractor to locate points/directions; v. use Cartesians systems to locate positions in x-y plane; vi. plot graph and draw inference from the graph. Candidates should be able to: i. distinguish between scalar and vector quantities; ii. give examples of scalar and vector quantities;

TOPICS/CONTENTS/NOTES	OBJECTIVES
	iii. determine the resultant of two or more vectors; iv. determine relative velocity; v. resolve vectors into two perpendicular components; vi. use graphical methods to solve vector problems.
3. Motion **(a) Types of motion:** translational, oscillatory, rotational, spin and random **(b) Relative motion** **(c) Causes of motion** **(d) Types of force** (i) contact (ii) force field **(e) linear motion** (i) speed, velocity and acceleration; (ii) equations of uniformly accelerated motion; (iii) motion under gravity; (iv) distance-time graph and velocity time graph; (v) instantaneous velocity and acceleration. **(f) Projectiles:** (i) calculation of range, maximum height and time of flight from the ground and a height; (ii) applications of projectile motion. **(g) Newton's laws of motion:** (i) inertia, mass and force; (ii) relationship between mass and acceleration; (iii) impulse and momentum;	Candidates should be able to; i. identify different types of motion; ii. solve numerical problem on collinear motion; iii. identify force as cause of motion; iv. identify push and pull as forms of force; v. identify electric and magnetic attractions, gravitational pull as forms of field forces; vi. differentiate between speed, velocity and acceleration; vii. deduce equations of uniformly accelerated motion; viii. solve problems of motion under gravity; ix. interpret distance-time graph and velocity-time graph; x. compute instantaneous velocity and acceleration; xi. establish expressions for the range, maximum height and time of flight of projectiles, rockets, missiles xii. solve problems involving projectile motion; xiii. solve numerical problems involving impulse and momentum; xiv. interpretation of area under force – time graph; xv. interpret Newton's laws of motion;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(iv) force – time graph; (v) conservation of linear momentum (Coefficient of restitution not necessary). **(h) Motion in a circle:** (i) angular velocity and angular acceleration; (ii) centripetal and centrifugal forces; (iii) applications. **(i) Simple Harmonic Motion (S.H.M):** (i) definition and explanation of simple harmonic motion; (ii) examples of systems that execute S.H.M; (iii) period, frequency and amplitude of S.H.M; (iv) velocity and acceleration of S.H.M; (iii) simple treatment of energy change in S.H.M; (iv) force vibration and resonance (simple treatment).	xvi. compare inertia, mass and force; xvii. deduce the relationship between mass and acceleration; xviii. interpret the law of conservation of linear momentum and application; xix. establish expression for angular velocity, angular acceleration and centripetal force; xx. solve numerical problems involving motion in a circle; xxi. establish the relationship between period and frequency; xxii. analyse the energy changes occurring during S.H.M; xxiii. identify different types of forced vibration; xxiv. enumerate applications of resonance.
4 Gravitational field (i) Newton's law of universal gravitation; (ii) gravitational potential; (iii) conservative and non-conservative fields; (iv) acceleration due to gravity; (v) variation of g on the earth's surface; (vi) distinction between mass and weight escape velocity; (vii) parking orbit and weightlessness.	Candidates should be able to: i. identify the expression for gravitational force between two bodies; ii. apply Newton's law of universal gravitation; iii. give examples of conservative and non-conservative fields; iv. deduce the expression for gravitational field potentials; v. identify the causes of variation of g on the earth's surface; vi. differentiate between mass and weight; vii. determine escape velocity.

TOPICS/CONTENTS/NOTES	OBJECTIVES
5. Equilibrium of Forces (a) **equilibrium of particles**: (i) equilibrium of coplanar forces; (ii) triangles and polygon of forces; (iii) Lami's theorem. (b) **principles of moments** (i) moment of a force; (ii) simple treatment and moment of a couple (torque); (iii) applications. **(c) conditions for equilibrium of rigid bodies under the action of parallel and non-parallel forces** (i) resolution and composition of forces in two perpendicular directions; (ii) resultant and equilibrant. **(d) centre of gravity and stability** (i) stable, unstable and neutral equilibra.	Candidates should be able to: i. apply the conditions for the equilibrium of coplanar forces to solve problems; ii. use triangle and polygon laws of forces to solve equilibrium problems; iii. use Lami's theorem to solve problems; iv. analyse the principle of moment of a force; v. determine moment of a force and couple; vi. describe some applications of moment of a force and couple; vii. apply the conditions for the equilibrium of rigid bodies to solve problems; viii. resolve forces into two perpendicular directions; ix. determine the resultant and equilibrant of forces; x. differentiate between stable, unstable and neutral equilibra.
6. (a) Work, Energy and Power **(i)** definition of work, energy and power; **(ii)** forms of energy; **(iii)** conservation of energy; **(iv)** qualitative treatment between different forms of energy; **(v)** interpretation of area under the force-distance curve.	Candidates should be able to: i. differentiate between work, energy and power; ii. compare different forms of energy, giving examples; iii. apply the principle of conservation of energy; iv. examine the transformation between different forms of energy; v. interpret the area under the force – distance curve. vi. solve numerical problems in work, energy and power.
(b) Energy and society (i) sources of energy; (ii) renewable and non-renewable energy e.g. coal, crude oil, sun, wind etc.; (iii) uses of energy;	Candidates should be able to: i. itemize the sources of energy; ii. distinguish between renewable and non-renewable energy, examples should be given;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(iv) energy and development; (v) energy diversification; (vi) environmental impact of energy e.g. global warming, greenhouse effect and spillage; (vii) energy crises; (viii) conversion of energy; (ix) devices used in energy production. **(c) Dams and energy production** (i) location of dams (ii) energy production **(d) nuclear energy** **(e) solar energy** (i) solar collector; (ii) solar panel for energy supply.	iii. identify methods of energy transition; iv. explain the importance of energy in the development of the society; v. analyze the effect of energy use to the environment; vi. identify the impact of energy on the environment; vii. identify energy sources that are friendly or hazardous to the environment; viii. identify energy uses in their immediate environment; ix. suggests ways of safe energy use x. state different forms of energy conversion.
7. Friction **(i)** static and dynamic friction; **(ii)** coefficient of limiting friction and its determination; **(iii)** advantages and disadvantages of friction **(iv)** reduction of friction; **(v)** qualitative treatment of viscosity and terminal velocity; **(vi)** Stoke's law.	Candidates should be able to: i. differentiate between static and dynamic friction; ii. determine the coefficient of limiting friction; iii. compare the advantages and disadvantages of friction; iv. suggest ways by which friction can be reduced; v. analyse factors that affect viscosity and terminal velocity; vi. apply Stoke's law.
8. Simple Machines **(i)** definition of simple machines; **(ii)** types of machines; **(iii)** mechanical advantage, velocity ratio and efficiency of machines.	Candidates should be able to: i. identify different types of simple machines; ii. solve problems involving simple machines.

TOPICS/CONTENTS/NOTES	OBJECTIVES
9. Elasticity: Hooke's Law and Young's Modulus **(i)** elastic limit, yield point, breaking point, Hooke's law and Young's modulus; **(ii)** the spring balance as a device for measuring force; (iii.) work done per unit volume in springs and elastic strings;	Candidates should be able to: i. interpret force-extension curves; ii. interpret Hooke's law and Young's modulus of a material; iii use spring balance to measure force; iv. determine the work done in spring and elastic strings.
10. Pressure **(**a) **Atmospheric Pressure** (i) definition of atmospheric pressure; (ii) units of pressure (S.I) units (Pa); (iii) measurement of pressure; (iv) simple mercury barometer; aneroid barometer and manometer; (v) variation of pressure with height; (vi) the use of barometer as an altimeter. (b) **Pressure in liquids** (i) the relationship between pressure, depth and density ($P = \rho gh$) (ii) transmission of pressure in liquids (Pascal's Principle) (iii) application	Candidates should be able to: i. recognize the S.I units of pressure (Pa); ii. identify pressure measuring instruments; iii. relate the variation of pressure to height; iv. use a barometer as an altimeter; v. determine the relationship between pressure depth and density; vi apply the principle of transmission of pressure in liquids to solve problems; vii. determine and apply the principle of pressure in liquid.
11. Liquids At Rest (i) determination of density of solids and liquids (ii) definition of relative density (iii) upthrust on a body immersed in a liquid (iv) Archimedes' principle and law of floatation and applications, e.g. ships and hydrometers.	Candidates should be able to: i. distinguish between density and relative density of substances; ii. determine the upthrust on a body immersed in a liquid; iii. apply Archimedes' principle and law of floatation to solve problems.
12. Temperature and Its Measurement (i) concept of temperature (ii) thermometric properties (iii) calibration of thermometers (iv) temperature scales –Celsius and Kelvin. (v) types of thermometers (vi) conversion from one scale of temperature to another	Candidates should be able to: i. identify thermometric properties of materials that are used for different thermometers; ii. calibrate thermometers;

TOPICS/CONTENTS/NOTES	OBJECTIVES
	iii. differentiate between temperature scales e.g. Celsius, Faranheight and Kelvin; iv. compare the types of thermometers; vi. convert from one scale of temperature to another.
13. Thermal Expansion **(a) Solids** **(i)** definition and determination of linear, volume and area expansivities; **(ii)** effects and applications, e.g. expansion in building strips and railway lines; **(iii)** relationship between different expansivities. (b) **Liquids** (i) volume expansivity; (ii) real and apparent expansivities; (iii) determination of volume expansivity; (iv) anomalous expansion of water.	Candidates should be able to: i. determine linear and volume expansivities; ii. assess the effects and applications of thermal expansivities; iii. determine the relationship between different expansivities; iv. determine volume, apparent, and real expansivities of liquids; v. analyse the anomalous expansion of water.
14. Gas Laws (i) Boyle's law (isothermal process) (ii) Charle's law (isobaric process) (iii) Pressure law (volumetric process) (iv) absolute zero of temperature (v) general gas equation: $(\frac{PV}{T}$ = constant) (vi) ideal gas equation Pv = nRT (iv) Van der waal gas	Candidates should be able to: i. interpret the gas laws; ii. use expression of these laws to solve numerical problems; iii. interpret Van der waal equation for one mole of a real gas.
15. Quantity of Heat (i) heat as a form of energy;	Candidates should be able to: i. differentiate between heat capacity and specific heat capacity;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(ii) definition of heat capacity and specific heat capacity of solids and liquids; (iii) determination of heat capacity and specific heat capacity of substances by simple methods e.g. method of mixtures and electrical method and Newton's law of cooling	ii. determine heat capacity and specific heat capacity using simple methods; iii. solve numerical problems.
16. Change of State **(i)** latent heat; **(ii)** specific latent heats of fusion and vaporization; **(iii)** melting, evaporation and boiling; **(iv)** the influence of pressure and of dissolved substances on boiling and melting points; **(v)** application in appliances.	Candidates should be able to: i. differentiate between latent heat and specific latent heats of fusion and vaporization; ii. differentiate between melting, evaporation and boiling; iii. examine the effects of pressure and of dissolved substance on boiling and melting points. iv. solve numerical problems.
17. Vapours **(i)** unsaturated and saturated vapours; **(ii)** relationship between saturated vapour pressure (S.V.P) and boiling; **(iii)** determination of S.V.P by barometer tube method; **(iv)** formation of dew, mist, fog, clouds and rain; **(v)** study of dew point, humidity and relative humidity; **(vi)** hygrometry; estimation of the humidity of the atmosphere using wet and dry bulb hygrometers.	Candidates should be able to: i. distinguish between saturated and unsaturated vapours; ii. relate saturated vapour pressure to boiling point; iii. determine S.V.P by barometer tube method; iv. differentiate between dew point, humidity and relative humidity; vi. estimate the humidity of the atmosphere using wet and dry bulb hygrometers; vii. solve numerical problems.
18. Structure of Matter and Kinetic Theory **(**a**) Molecular nature of matter** **(i)** atoms and molecules; **(ii)** molecular theory: explanation of Brownian motion, diffusion, surface tension, capillarity, adhesion, cohesion and angles of contact law of definite proportion; **(iii)** examples and applications.	Candidates should be able to: i. differentiate between atoms and molecules; ii. use molecular theory to explain Brownian motion, diffusion, surface, tension, capillarity, adhesion, cohesion and angle of contact;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(b) **Kinetic Theory** (i) assumptions of the kinetic theory (ii) using the theory to explain the pressure exerted by gas, Boyle's law, Charles' law, melting, boiling, vapourization, change in temperature, evaporation, etc.	iii. examine the assumptions of kinetic theory; iv. interpret kinetic theory, the pressure exerted by gases, Boyle's law, Charles's law, melting, boiling, vaporization, change in temperature, evaporation, etc.
19. Heat Transfer (i) conduction, convection and radiation as modes of heat transfer; (ii) temperature gradient, thermal conductivity and heat flux; (iii) effect of the nature of the surface on the energy radiated and absorbed by it; (iv) the conductivities of common materials; (v) the thermos flask and vacuum flask; (vi) land and sea breeze; (vii) combustion engine.	Candidates should be able to: i. differentiate between conduction, convection and radiation as modes of heat transfer; ii. solve problems on temperature gradient, thermal conductivity and heat flux; iii. assess the effect of the nature of the surface on the energy radiated and absorbed by it; iv. compare the conductivities of common materials; v. relate the component part of the working of the thermos flask; vi. differentiate between land and sea breeze; vii. analyse the principles of operating internal combustion jet engines, rockets.
20. Waves (a) **Production and Propagation** (i) wave motion; (ii) vibrating systems as source of waves; (iii) waves as mode of energy transfer; (iv) distinction between particle motion and wave motion; (v) relationship between frequency, wavelength and wave velocity ($V=f\lambda$); (vi) phase difference, wave number and wave vector; (vii) progressive wave equation e.g. $Y = A \sin \frac{2\pi}{\lambda}(vt \pm \times)$	Candidates should be able to: i. interpret wave motion; ii. identify vibrating systems as sources of waves; iii use waves as a mode of energy transfer; iv distinguish between particle motion and wave motion; v. relate frequency and wave length to wave velocity; vi. determine phase difference, wave number and wave vector; vii. use the progressive wave equation to compute basic wave parameters;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(b) **Classification** (i) types of waves; mechanical and electromagnetic waves; (ii) longitudinal and transverse waves; (iii) stationary and progressive waves; (iv) examples of waves from springs, ropes, stretched strings and the ripple tank.	viii. differentiate between mechanical and electromagnetic waves; ix. differentiate between longitudinal and transverse waves; x. distinguish between stationary and progressive waves; xi. indicate the example of waves generated from springs, ropes, stretched strings and the ripple tank;
(c) Characteristics/Properties **(i)** reflection, refraction, diffraction and plane polarization; **(ii)** superposition of waves e.g. interference **(iii)** Beats; **(iv)** Doppler effects (qualitative treatment only).	xii. differentiate between reflection, refraction, diffraction and plane polarization of waves; xiii. analyse the principle of superposition of waves; xiv. solve numerical problems on waves explain the phenomenon of beat, beat frequency and uses; xv. explain Doppler effect of sound and application
21. Propagation of Sound Waves (i) the necessity for a material medium; (ii) speed of sound in solids, liquids and air; (iii) reflection of sound; echoes, reverberation and their applications; (v) advantages and disadvantages of echoes and reverberations.	Candidates should be able to: i. determine the need for a material medium in the propagation of sound waves; ii. compare the speed of sound in solids, liquids and air; iii. relate the effects of temperature and pressure to the speed of sound in air; iv. solve problem on echoes, reverberation and speed; v. compare the disadvantages and advantages of echoes. vi. solve problems on echo, reverberation and speed of sound.
22. Characteristics of Sound Waves (i) noise and musical notes; (ii) quality, pitch, intensity and loudness and their application to musical instruments; (iii) simple treatment of harmonics and overtones produced by vibrating strings and their columns	Candidates should be able to: i. differentiate between noise and musical notes; ii. analyse quality, pitch, intensity and loudness of sound notes; iii. evaluate the application of (ii) above in the construction of musical instruments;

TOPICS/CONTENTS/NOTES	OBJECTIVES
$F_o = \frac{1}{2L}\sqrt{\frac{T}{\mu}}\ (\mu = m/l)$ (iv) acoustic examples of resonance; (v) frequency of a note emitted by air columns in closed and open pipes in relation to their lengths.	iv. identify overtones by vibrating stings and air columns; iv. itemize acoustical examples of resonance; vi. determine the frequencies of notes emitted by air columns in open and closed pipes in relation to their lengths.
23. Light Energy **(a) Sources of Light** (i) natural and artificial sources of light; (ii) luminous and non-luminous objects. **(b) Propagation of light** (i) speed, frequency and wavelength of light; (ii) formation of shadows and eclipse; (iii) the pin-hole camera.	Candidates should be able to: i. compare the natural and artificial sources of light; ii. differentiate between luminous and non luminous objects; iii. relate the speed, frequency and wavelength of light; iv. interpret the formation of shadows and eclipses; v. solve problems using the principle of operation of a pin-hole camera.
24. Reflection of Light at Plane and Curved Surfaces **(i)** laws of reflection; **(ii)** application of reflection of light; **(iii)** formation of images by plane, concave and convex mirrors and ray diagrams; **(iv)** use of the mirror formula: $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ **(v)** linear and angular magnification.	Candidates should be able to: i. interpret the laws of reflection; ii. illustrate the formation of images by plane, concave and convex mirrors; iii. apply the mirror formula to solve optical problems; iv. determine the linear magnification; v. apply the laws of reflection of light to the working of periscope, kaleidoscope and the sextant.
25. Refraction of Light Through at Plane and Curved Surfaces (i) explanation of refraction in terms of velocity of light in the media; (ii) laws of refraction; (iii) definition of refractive index of a medium; (iv) determination of refractive index of glass and liquid using Snell's law; (v) real and apparent depth and lateral	Candidates should be able to: i. interpret the laws of reflection; ii. determine the refractive index of glass and liquid using Snell's law; iii. determine the refractive index using the principle of real and apparent depth; iv. determine the conditions necessary for total internal reflection;

TOPICS/CONTENTS/NOTES	OBJECTIVES
displacement; (vi) critical angle and total internal reflection. **(b) Glass Prism** (i) use of the minimum deviation formula: $U = \frac{\sin\left[\frac{A+D}{2}\right]}{\sin\left[\frac{A}{2}\right]}$ (ii) type of lenses: triangular, rectangular etc (iii) use of lens formula: $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ and Newton's formular ($F^2 = ab$) (iv) magnification.	v. examine the use of periscope, prism, binoculars, optical fibre; vi. apply the principles of total internal reflection to the formation of mirage; vii. use of lens formula and ray diagrams to solve optical numerical problems; viii. determine the magnification of an image; ix. calculate the refractive index of a glass prism using minimum deviation formula.
26. Optical Instruments (i) general principles of microscopes, telescopes, projectors, cameras and the human eye (physiological details of the eye are not required); (ii) power of a lens; (iii) angular magnification; (iv) near and far points; (v) sight defects and their corrections.	Candidates should be able to: i. apply the principles of operation of optical instruments to solve problems; ii. distinguish between the human eye and the cameras; iii. calculate the power of a lens; iv. evaluate the angular magnification of optical instruments; v. determine the near and far points; vi. detect sight defects and their corrections.
27. (a) Dispersion of light and colours (i) dispersion of white light by a triangular Prism; (ii) production of pure spectrum; (iii) colour mixing by addition and subtraction; (iv) colour of objects and colour filters; (v) rainbow and formation.	Candidates should be able to: i. identify primary colours and obtain secondary colours by mixing; ii. understand the formation of rainbow; iii. deduce why objects have colours; iv. relate the expression for gravitational force between two bodies; v. apply Newton's law of universal gravitation; vi. analyse colours using colour filters;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(b) Electromagnetic spectrum (i) description of sources and uses of various types of radiation.	vii. analyse the electromagnetic spectrum in relation to their wavelengths, sources, detection and uses.
28. Electrostatics (i) existence of positive and negative charges in matter; (ii) charging a body by friction, contact and induction; (iii) electroscope; (iv) Coulomb's inverse square law, electric field and potential; (v) electric field intensity potential and potential difference; (vi) electric discharge and lightning.	Candidates should be able to: i. identify charges; ii. examine uses of an electroscope; iii. apply Coulomb's square law of electrostatics to solve problems; iv. deduce expressions for electric field intensity and potential difference; v. identify electric field flux patterns of isolated and interacting charges; vi. analyse the distribution of charges on a conductor and how it is used in lightening conductors.
29. Capacitors (i) types and functions of capacitors; (ii) parallel plate capacitors; (iii) capacitance of a capacitor; (iv) the relationship between capacitance, area separation of plates and medium between the plates $C = \frac{EA}{d}$ (v) capacitors in series and parallel; (vi) energy stored in a capacitor.	Candidates should be able to: i. determine uses of capacitors; ii. analyse parallel plate capacitors; iii. determine the capacitance of a capacitor; iv. analyse the factors that affect the capacitance of a capacitor; v. solve problems involving the arrangement of a capacitor; vi. determine the energy stored in capacitors.
30. Electric Cells (i) simple voltaic cell and its defects; (ii) Daniel cell, Leclanche cell (wet and dry); (iii) lead –acid accumulator and Nickel-Iron (Nife) Lithium lon and Mercury cadmium; (iv) maintenance of cells and batteries (detail treatment of the chemistry of a cell is not required); (vi) arrangement of cells; (vii) efficiency of a cell.	Candidates should be able to: i. identify the defects of the simple voltaic cell and their correction; ii. compare different types of cells including solar cell; iii. compare the advantages of lead-acid and Nikel iron accumulator; iv. solve problems involving series and parallel combination of cells.

TOPICS/CONTENTS/NOTES	OBJECTIVES
31. Current Electricity (i) electromagnetic force (emf), potential difference (p.d.), current, internal resistance of a cell and lost Volt; (ii) Ohm's law, resistivity and conductivity; (iii) measurement of resistance; (iv) meter bridge; (v) resistance in series and in parallel and their combination; (vi) the potentiometer method of measuring emf, current and internal resistance of a cell. (i) electrical networks.	Candidates should be able to: i. differentiate between emf, p.d., current and internal resistant of a cell; ii. apply Ohm's law to solve problems; iii. use metre bridge to calculate resistance; iv. compute effective total resistance of both parallel and series arrangement of resistors; v. determine the resistivity and the conductivity of a conductor; vi. measure emf. current and internal resistance of a cell using the potentiometer; vii. identify the advantages of the potentiometer; viii. apply Kirchoff's law in electrical networks.
32. Electrical Energy and Power (i) concepts of electrical energy and power; (ii) commercial unit of electric energy and power; (iii) electric power transmission (v) heating effects of electric current; (vi) electrical wiring of houses; (vii) use of fuses.	Candidates should be able to: i. apply the expressions of electrical energy and power to solve problems; ii. analyse how power is transmitted from the power station to the consumer; iii. identify the heating effects of current and its uses; iv. identify the advantages of parallel arrangement over series; v. determine the fuse rating.
33. Magnets and Magnetic Fields (i) natural and artificial magnets; (ii) magnetic properties of soft iron and steel; (iii) methods of making magnets and demagnetization; (iv) concept of magnetic field; (v) magnetic field of a permanent magnet; (vi) magnetic field round a straight current carrying conductor, circular wire and solenoid; (vii) properties of the earth's magnetic field; north and south poles, magnetic meridian and angle of dip and declination;	Candidates should be able to: i. give examples of natural and artificial magnets; ii. differentiate between the magnetic properties of soft iron and steel; iii. identify the various methods of making magnets and demagnetizing magnets; iv. describe how to keep a magnet from losing its magnetism; v. determine the flux pattern exhibited when two magnets are placed together pole to pole;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(viii) flux and flux density; (ix) variation of magnetic field intensity over the earth's surface (x)applications: earth's magnetic field in navigation and mineral exploration.	vi. determine the flux of a current carrying conductor, circular wire and solenoid including the polarity of the solenoid; vii. determine the flux pattern of a magnet placed in the earth's magnetic fields; viii. identify the magnetic elements of the earth's flux; ix. determine the variation of earth's magnetic field on the earth's surface; x. examine the applications of the earth's magnetic field.
34. Force on a Current-Carrying Conductor in a Magnetic Field (i) quantitative treatment of force between two parallel current-carrying conductors; (ii) force on a charge moving in a magnetic field; (iii) the d. c. motor; (iv) electromagnets; (v) carbon microphone; (vi) moving coil and moving iron instruments; (viii) conversion of galvanometers to ammeters and voltmeter using shunts and multipliers; (ix) sensitivity of a galvanometer.	Candidates should be able to: i. determine the direction of force on a current carrying conductor using Fleming's left-hand rule; ii. interpret the attractive and repulsive forces between two parallel current-carrying conductors using diagrams; iii. determine the relationship between the force, magnetic field strength, velocity and the angle through which the charge enters the field; iv. interpret the working of the d. c. motor; v. analyse the principle of electromagnets and give examples of its application; vi. compare moving iron and moving coil instruments; vii. convert a galvanometer into an ammeter or a voltmeter; viii. identify the factors affecting the sensitivity of a galvanometer.
35. (a) Electromagnetic Induction (i) Faraday's laws of electromagnetic induction; (ii) factors affecting induced emf; (iii) Lenz's law as an illustration of the principle of conservation of energy; (iv) a.c. and d.c generators; (v) transformers; (vi) the induction coil.	Candidates should be able to: i. interpret the laws of electromagnetic induction; ii. identify factors affecting induced emf; iii. recognize how Lenz's law illustrates the principle of conservation of energy; iv. interpret the diagrammatic set up of A. C. generators;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(b) Inductance (i) explanation of inductance; (ii) unit of inductance; (iii) energy stored in an inductor: $E=\frac{1}{2} I^2L$ (iv) application/uses of inductors. **(c) Eddy Current** (i) reduction of eddy current (ii) applications of eddy current	v. identify the types of transformer; vi. examine principles of operation of transformers; vii. assess the functions of an induction coil; viii. draw some conclusions from the principles of operation of an induction coil; ix. interpret the inductance of an inductor; x. recognize units of inductance; xi. calculate the effective total inductance in series and parallel arrangement; xii. deduce the expression for the energy stored in an inductor; xiii. examine the applications of inductors; xiv. describe the method by which eddy current losses can be reduced; xv. determine ways by which eddy currents can be used.
36. Simple A. C. Circuits (i) explanation of a.c. current and voltage; (ii) peak and r.m.s. values; (iii) a.c. source connected to a resistor; (iv) a.c source connected to a capacitor-(capacitive reactance); (v) a.c source connected to an inductor (inductive reactance); (vi) R-L-C circuits; (vii) vector diagram, phase angle and power factor; (viii) resistance and impedance; (ix) effective voltage in an R-L-C circuits; (x) resonance and resonance frequency: $F_0 = \frac{1}{2\pi\sqrt{LC}}$	Candidates should be able to: i. identify a.c. current and d.c. voltage; ii. differentiate between the peak and r.m.s. values of a.c.; iii. determine the phase difference between current and voltage; iv. interpret R-L-C circuits; v. analyse vector diagrams; vi. calculate the effective voltage, reactance and impedance; vii. recognize the condition by which the circuit is at resonance; viii. determine the resonant frequency of R-L-C arrangement; ix. determine the instantaneous power, average power and the power factor in a. c. circuits.
37. Conduction of Electricity Through **(a) liquids** (i) electrolytes and non-electrolyte; (ii) concept of electrolysis; (iii) Faraday's laws of electrolysis;	Candidates should be able to: i. distinguish between electrolytes and non-electrolytes; ii. analyse the processes of electrolysis; iii. apply Faraday's laws of electrolysis to solve problems;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(iv) application of electrolysis, e.g. electroplating, calibration of ammeter etc. **(b) gases** (i) discharge through gases (qualitative treatment only); (ii) application of conduction of electricity through gases; **38. Elementary Modern Physics-Bohr's Theory** (i) models of the atom and their limitations; (ii) elementary structure of the atom; (iii) energy levels and spectra; (iv) thermionic and photoelectric emissions; (v) Einstein's equation and stopping potential (vi) applications of thermionic emissions and photoelectric effects; (vii) simple method of production of x-rays; (viii) properties and applications of alpha, beta and gamma rays; (ix) half-life and decay constant; (x) simple ideas of production of energy by fusion and fission; (xi) binding energy, mass defect and Einstein's Energy equation $[\Delta E = \Delta Mc^2]$ (xii) wave-particle (duality of matter); (xiii) electron diffraction; (xiv) the uncertainty principle.	iv. analyse discharge through gases; v. determine some applications/uses of conduction of electricity through gases. Candidates should be able to: i. identify the models of the atom and write their limitations; ii. describe elementary structure of the atom; iii. differentiate between the energy levels and spectra of atoms; iv. compare thermionic emission and photoelectric emission; v. apply Einstein's equation to solve problems of photoelectric effect; vi. calculate the stopping potential; vii. relate some application of thermionic emission and photoelectric effects; viii. interpret the process involved in the production of x-rays; ix. identify some properties and applications of x-rays; x. analyse elementary radioactivity; xi. distinguish between stable and unstable nuclei; xii. identify isotopes of an element; xiii. compare the properties of alpha, beta and gamma rays; xiv. relate half-life and decay constant of a radioactive element; xv. determine the binding energy, mass defect and Einstein's energy equation; xvi. analyse wave particle duality; xvii. solve some numerical problems based on the uncertainty principle and wave – particle duality.

TOPICS/CONTENTS/NOTES	OBJECTIVES
39. Introductory Electronics (i) distinction between metals, semiconductors and insulators (elementary knowledge of band gap is required); (ii) intrinsic and extrinsic semiconductors (n-type and p-type semiconductors); (iii) uses of semiconductors and diodes in rectification and transistors in amplification; (iv) elementary knowledge of diodes and transistors.	Candidates should be able to: i. differentiate between conductors, semi-conductors and insulators; ii. distinguish between intrinsic and extrinsic semiconductors (n-type and p-type semiconductors); iii. distinguish between electron and hole carriers; iv. analyse diodes and transistor v. relate diodes to rectification and transistor to amplification.

RECOMMENDED TEXTS

Ike, E.E. (2014). *Essential Principles of Physics*, Jos ENIC Publishers.

Ike, E.E. (2014). *Numerical Problems and Solutions in Physics*, Jos: ENIC Publishers.

Nelkon, M. (1977). *Fundamentals of Physics,* Great Britain: Hart Davis Education.

Nelkon, M. and Parker … (1989). *Advanced Level Physics*, (Sixth Edition): Heinemann.

Okeke, P.N. and Anyakoha, M.W. (2000). *Senior Secondary School Physics*, Lagos: Pacific Printers.

Olumuyiwa, Awe. and Ogunkoya, O. O. (1992). *Comprehensive Certificate Physics*, Ibadan: University Press Plc.

CHEMISTRY

GENERAL OBJECTIVES

The aim of the Unified Tertiary Matriculation Examination (UTME) syllabus in Chemistry is to prepare the candidates for the Board's examination. It is designed to test their comprehension of the course objectives, which are to:

(i) understand the basic principles and concepts in chemistry;
(ii) Interpret scientific data relating to chemistry;
(iii) deduce the relationships between chemistry and other sciences; and
(iv) apply the knowledge of chemistry to industry and everyday life.

DETAILED SYLLABUS

TOPICS/CONTENTS/NOTES	OBJECTIVES
1. Separation of Mixtures and Purification of Chemical Substances	Candidates should be able to:
(a) Pure and impure substances	(i) distinguish between pure and impure substances;
(b) Boiling and melting points	(ii) use boiling and melting points as criteria for purity of chemical substances;
(c) Elements, compounds and mixtures	(iii) distinguish between elements, compounds and mixture;
(d) Chemical and physical changes	(iv) differentiate between chemical and physical changes;
(e) Separation processes: Evaporation, simple and fractional distillation, sublimation, filtration, crystallization, paper and column chromatography, simple and fractional crystallization, magnetization, decantation.	(v) identify the properties of the components of a mixture; (vi) specify the principle involved in each separation method; and (vii) apply the basic principle of separation processes in everyday life.
2. Chemical Combination Laws of definite, multiple and reciprocal proportions, law of conservation of matter, Gay Lussac's law of combining volumes, Avogadro's law; chemical symbols, formulae, equations and their uses, relative atomic mass based on $^{12}C=12$, the mole concept and Avogadro's number and stoichiometry of reactions.	Candidates should be able to: (i) perform simple calculations involving formulae, equations/chemical composition and the mole concept; (ii) deduce the chemical laws from given expressions/statements/data; (iii) interpret graphical representations related to these laws; and (iv) deduce the stoichiometry of chemical reactions.
3. Kinetic Theory of Matter and Gas Laws	Candidates should be able to:
(a) Phenomena to support the kinetic theory of matter using	(i) apply the theory to distinguish between solids, liquids and gases;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(i) melting, (ii) vapourization (iii) boiling (iv) freezing (v) condensation in terms of molecular motion and Brownian movement. (b) (i) The laws of Boyle, Charles, Graham and Dalton (law of partial pressure); combined gas law, molar volume and atomicity of gases. (ii) The ideal gas equation (PV = nRT). (iii) The relationship between vapour density of gases and the relative molecular mass.	(ii) deduce reasons for change of state; (iii) draw inferences based on molecular motion; (iv) deduce gas laws from given expressions/statements; (v) interpret graphical representations related to these laws; and (vi) perform simple calculations based on these laws, equations and relationships.
4. Atomic Structure and Bonding	Candidates should be able to:
(a) (i)The concept of atoms, molecules and ions, the works of Dalton, Millikan, Rutherford, Moseley, Thompson and Bohr. (ii) Atomic structure, electron configuration, atomic number, mass number and isotopes; specific examples should be drawn from elements of atomic number 1 to 20. (iii) Shapes of *s* and *p* orbitals. (b) The periodic table and periodicity of elements, presentation of the periodic table with a view to recognizing families of elements e.g. alkali metals, halogens, the noble gases and transition metals. The variation of the following properties: ionization energy, ionic radii, electron affinity and electronegativity. (c) Chemical bonding. Electrovalency and covalency, the electron configuration of elements and their tendency to attain the noble gas structure. Hydrogen bonding and metallic bonding as special types of electrovalency and covalency respectively; coordinate bond as a type of covalent bond as illustrated by complexes like $[Fe(CN)_6]^{3-}$, $[Fe(CN)_6]^{4-}$, $[Cu(NH_3)_4]^{2+}$and $[Ag(NH_3)_2]^{+}$; van der Waals' forces should be mentioned as a special type of bonding forces. (d) Shapes of simple molecules: linear ((H_2, O_2, $C1_2$, HCl and CO_2), non-linear (H_2O), tetrahedral; (CH_4) and pyramidal (NH_3).	(i) distinguish between atoms, molecules and ions; (ii) identify the contributions of these scientists to the development of the atomic structure; (iii) deduce the number of protons, neutrons and electrons from atomic and mass numbers of an atom; (iv) apply the rules guiding the arrangement of electrons in an atom; (v) identify common elements exhibiting isotopy; (vi) relate isotopy to mass number; (vii) perform simple calculations relating to isotopy; (viii) differentiate between the shapes of the orbitals; (ix) determine the number of electrons in *s* and *p* atomic orbitals; (x) relate atomic number to the position of an element on the periodic table; (xi) relate properties of groups of elements on the periodic table; (xii) identify reasons for variation in properties across the period and down the groups; (xiii) differentiate between the different types of bonding; (xiv) deduce bond types based on electron configurations; (xv) relate the nature of bonding to properties of compounds; (xvi) differentiate between the various shapes of molecules;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(e) Nuclear Chemistry: (i) Radioactivity – Types and properties of radiations (ii) Nuclear reactions. Simple equations, uses and applications of natural and artificial radioactivity.	xvii) distinguish between ordinary chemical reaction and nuclear reaction; (xviii) differentiate between natural and artificial radioactivity; (xix) compare the properties of the different types of nuclear radiations; (xx) compute simple calculations on the half-life of a radioactive material; (xxi) balance simple nuclear equation; and (xxii) identify the various applications of radioactivity.
5. Air	Candidates should be able to:
(a) The natural gaseous constituents and their proportion in the air. – nitrogen, oxygen, water vapour, carbon (IV) oxide and the noble gases (argon and neon). (b) Air as a mixture and some uses of the noble gas.	(i) deduce reason (s) for the existence of air as a mixture; (ii) identify the principle involved in the separation of air components; (iii) deduce reasons for the variation in the composition of air in the environment; and (iv) specify the uses of some of the constituents of air.
6. Water	Candidates should be able to:
(a) Water as a product of the combustion of hydrogen and its composition by volume. (b) Water as a solvent, atmospheric gases dissolved in water and their biological significance. (c) Hard and soft water: Temporary and permanent hardness and methods of softening hard water. (d) Treatment of water for town supply. (e) Water of crystallization, efflorescence, deliquescence and hygroscopy. Example of the substances exhibiting these properties and their uses.	(i) identify the various uses of water; (ii) identify the effects of dissolved atmospheric gases in water; (iii) distinguish between the properties of hard and soft water; (iv) determine the causes of hardness; (v) identify methods of removal of hardness; (vi) describe the processes involved in the treatment of water for town supply; (vii) distinguish between these phenomena; and (viii) identify the various compounds that exhibit these phenomena.
7. Solubility	Candidates should be able to:
(a) Unsaturated, saturated and supersaturated solutions. Solubility curves and simple deductions from them, (solubility defined in terms of mole per dm^3) and simple calculations.	(i) distinguish between the different types of solutions; (ii) interpret solubility curves; (iii) calculate the amount of solute that can dissolve in a given amount of solvent at a given temperature; (iv) deduce that solubility is temperature-dependent;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(b) Solvents for fats, oil and paints and the use of such solvents for the removal of stains.	(v) relate nature of solvents to their uses;
(c) True and False solutions (Suspensions and colloids): Properties and examples. Harmattan haze and water paints as examples of suspensions and fog, milk, aerosol spray, emulsion paints and rubber solution as examples of colloids.	(vi) differentiate among true solutions, suspensions and colloids; (vii) compare the properties of a 'true' solution and a 'false' solution; and (viii) provide typical examples of suspensions and colloids.
8. Environmental Pollution	Candidates should be able to:
(a) Sources and effects of pollutants.	(i) identify the different types of pollution and pollutants;
(b) Air pollution: Examples of air pollutants such as H_2S, CO, SO_2, oxides of nitrogen, chlorofluorocarbons and dust.	(ii) specify different sources of pollutants; (iii) classify pollutants as biodegradable and non-biodegradable;
(c) Water pollution Sewage and oil pollution should be known.	(iv) specify the effects of pollution on the environment; and
(d) Soil pollution: Oil spillage, biodegradable and non-biodegradable pollutants.	(v) identify measures for control of environmental pollution.
9. Acids, Bases and Salts	Candidates should be able to:
(a) General characteristics, properties and uses of acids, bases and salts. Acids/base indicators, basicity of acids; normal, acidic, basic and double salts. An acid defined as a substance whose aqueous solution furnishes H_3O^+ions or as a proton donor. Ethanoic, citric and tartaric acids as examples of naturally occurring organic acids, alums as examples of double salts, preparation of salts by neutralization, precipitation and action of acids on metals. Oxides and trioxocarbonate (IV) salts	(i) distinguish between the properties of acids and bases; (ii) identify the different types of acids and bases; (iii) determine the basicity of acids; (iv) differentiate between acidity and alkalinity using acid/base indicators; (v) identify the various methods of preparation of salts; (vi) classify different types of salts;
(b) Qualitative comparison of the conductance of molar solutions of strong and weak acids and bases, relationship between conductance and amount of ions present.	(vii) relate degree of dissociation to strength of acids and bases; (viii) relate degree of dissociation to conductance;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(c) pH and pOH scale; Simple calculations	(ix) perform simple calculations on pH and pOH;
(d) Acid/base titrations.	(x) identify the appropriate acid-base indicator; (xi) interpret graphical representation of titration curves; (xii) perform simple calculations based on the mole concept;
(e) Hydrolysis of salts: Simple examples such as NH_4Cl, $AlCl_3$, $Na_2CO_3$and CH_3COONa	(xiii) balance equations for the hydrolysis of salts; and (xiv) deduce the properties (acidic, basic, neutral) of the resultant solution.
10. Oxidation and Reduction - Redox	Candidates should be able to:
(a) Oxidation in terms of the addition of oxygen or removal of hydrogen. (b) Reduction as removal of oxygen or addition of hydrogen. (c) Oxidation and reduction in terms of electron transfer. (d) Use of oxidation numbers. Oxidation and reduction treated as change in oxidation number and use of oxidation numbers in balancing simple equations. (e) IUPAC nomenclature of inorganic compounds using oxidation number. (f) Tests for oxidizing and reducing agents.	(i) identify the various forms of expressing oxidation and reduction; (ii) classify chemical reactions in terms of oxidation or reduction; (iii) balance redox reaction equations; (iv) deduce the oxidation number of chemical species; (v) compute the number of electron transfer in redox reactions; (vi) identify the name of redox species in a reaction (vii) distinguish between oxidizing and reducing agents in redox reactions; (viii) apply oxidation number in naming inorganic compounds; and (ix) relate reagents to their oxidizing and reducing abilities.
11. Electrolysis	Candidates should be able to:
(a) Electrolytes and non-electrolytes. Faraday's laws of electrolysis. (b) (i) Electrolysis of dilute H_2SO_4, aqueous $CuSO_4$, $CuC1_2$ solution, dilute and concentrated NaC1 solutions and fused NaC1 (ii) Factors affecting discharge of ions at the electrodes.	(i) distinguish between electrolytes and non-electrolytes; (ii) perform calculations based on faraday as mole of electrons; (iii) identify suitable electrodes for different electrolytes; (iv) specify the chemical reactions at the electrodes; (v) determine the products at the electrodes; (vi) identify the factors that affect the products of electrolysis;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(c) Uses of electrolysis: Purification of metals e.g. copper and production of elements and compounds (Al, Na, O_2, Cl_2 and NaOH).	(vii) specify the different areas of application of electrolysis;
(d) Electrochemical cells: Electrochemical series (K, Ca,Na, Mg, Al, Zn, Fe, Sn, Pb, H, Cu, Hg, Ag, Au,) half-cell reactions and electrode potentials. (Simple calculations only).	(viii) identify the various electrochemical cells; (ix) calculate electrode potentials using half-cell reaction equations;
(e) Corrosion as an electrolytic process, cathodic protection of metals, painting, electroplating and coating with grease or oil as ways of preventing iron from corrosion.	(x) determine the different areas of application of electrolytic processes; and (xi) identify methods used in protecting metals.
12. Energy Changes	Candidates should be able to:
(a) Energy changes(ΔH) accompanying physical and chemical changes: dissolution of substances in/or reaction with water e.g. Na, NaOH, K, NH_4Cl. Endothermic ($+\Delta H$) and exothermic ($-\Delta H$) reactions. (b) Entropy as an order-disorder phenomenon: simple illustrations like mixing of gases and dissolution of salts. (c) Spontaneity of reactions: $\Delta G^{\theta} = 0$ as a criterion for equilibrium, ΔG greater or less than zero as a criterion for non-spontaneity or spontaneity respectively.	(i) determine the types of heat changes (ΔH) in physical and chemical processes; (ii) interpret graphical representations of heat changes; (iii) relate the physical state of a substance to the degree of orderliness; (iv) determine the conditions for spontaneity of a reaction; (v) relate ΔH^{θ}, ΔS^{θ} and ΔG^{θ} as the driving forces for chemical reactions; and (vi) solve simple problems based on the relationships $\Delta G^{\theta} = \Delta H^{\theta} - T\Delta S^{\theta}$
13. Rates of Chemical Reaction	Candidates should be able to:
(a) Elementary treatment of the following factors which can change the rate of a chemical reaction: (i) Temperature e.g. the reaction between HCl and $Na_2S_2O_3$ or Mg and HCl	(i) identify the factors that affect the rates of a chemical reaction; (ii) determine the effects of temperature on the rate of reactions;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(ii) Concentration/pressure e.g. the reaction between HCl and $Na_2S_2O_3$, HCl and marble and the iodine clock reaction, for gaseous systems, pressure may be used as concentration term. (iii) Surface area e.g. the reaction between marble and HCl with marble in (i) powdered form (ii) lumps of the same mass. (iv) Catalyst e.g. the decomposition of H_2O_2 or $KClO_3$ in the presence or absence of MnO_2 (b) Reaction rate curves. (c) Activation energy Qualitative treatment of Arrhenius' law and the collision theory, effect of light on some reactions. e.g. halogenation of alkanes	(iii) examine the effect of concentration/pressure on the rate of a chemical reaction; (iv) describe how the rate of a chemical reaction is affected by surface area; (v) determine the types of catalysts suitable for different reactions and their effects; (vi) determine ways of moderating these effects in chemical reactions; (vii) interpret reaction rate curves; (viii) solve simple problems on the rate of reactions; (ix) relate the rate of reaction to the kinetic theory of matter. (x) examine the significance of activation energy to chemical reactions; and (xi) deduce the value of activation energy (Ea) from reaction rate curves.
14. Chemical Equilibra Reversible reactions and factors governing the equilibrium position. Dynamic equilibrium. Le Chatelier's principle and equilibrium constant. Simple examples to include action of steam on iron and $N_2O_4 \rightleftharpoons 2NO_2$. No calculation will be required.	Candidates should be able to: (i) identify the factors that affect the position of equilibrium of a chemical reaction; (ii) predict the effects of each factor on the position of equilibrium; and (iii) determine the effects of these factors on equilibrium constant.
15. Non-metals and Their Compounds (a) Hydrogen: commercial production from water gas and cracking of petroleum fractions, laboratory preparation, properties, uses and test for hydrogen. (b) Halogens: Chlorine as a representative element of the halogen. Laboratory preparation, industrial preparation by electrolysis, properties and uses, e.g. water sterilization, bleaching, manufacture of HCl, plastics and insecticides.	Candidates should be able to: (i) predict reagents for the laboratory and industrial preparation of these gases and their compounds; (ii) identify the properties of the gases and their compounds; (iii) compare the properties of these gases and their compounds; (iv) specify the uses of each gas and its compounds; (v) determine the specific test for each gas and its compounds; (vi) determine specific tests for Cl^-, SO_4^{2-}, SO_3^{2-}, S^{2-},NH_4^+, NO_3^-, CO_3^{2-}, HCO_3^-

TOPICS/CONTENTS/NOTES	OBJECTIVES
Hydrogen chloride and Hydrochloric acid: Preparation and properties. Chlorides and test for chlorides. (c) Oxygen and Sulphur (i) Oxygen: Laboratory preparation, properties and uses. Commercial production from liquid air. Oxides: Acidic, basic, amphoteric and neutral, trioxygen (ozone) as an allotrope and the importance of ozone in the atmosphere. (ii) Sulphur: Uses and allotropes: preparation of allotropes is not expected. Preparation, properties and uses of sulphur (IV) oxide, the reaction of SO_2 with alkalis. Trioxosulphate (IV) acid and its salts, the effect of acids on salts of trioxosulphate (IV), Tetraoxosulphate (VI) acid: Commercial preparation (contact process only), properties as a dilute acid, an oxidizing and a dehydrating agents and uses. Test for SO_4^{2-}. Hydrogen sulphide: Preparation and properties as a weak acid, reducing and precipitating agents. Test for S^{2-} (d) Nitrogen: (i) Laboratory preparation (ii) Production from liquid air (iii) Ammonia: Laboratory and industrial preparations (Haber Process only), properties and uses, ammonium salts and their uses, oxidation of ammonia to nitrogen (IV) oxide and trioxonitrate (V) acid. Test for NH_4^+ (iv) Trioxonitrate (V) acid: Laboratory preparation from ammonia; properties and uses. Trioxonitrate (V) salt-action of heat and uses. Test for NO_3^- (v) Oxides of nitrogen: Properties.	(vii) predict the reagents for preparation, properties and uses of $HCl_{(g)}$ and $HCl_{(aq)}$; (viii) identify the allotropes of oxygen; (ix) determine the significance of ozone to our environment; (x) classify the oxides of oxygen and their properties; (xi) identify the allotropes of sulphur and their uses; (xii) predict the reagents for preparation, properties and uses of $SO_2$and H_2S; (xiii) specify the preparations of H_2SO_4 and H_2SO_3, their properties and uses; (xiv) specify the laboratory and industrial preparation of NH_3; (xv) identify the properties and uses of NH_3; (xvi) identify reagents for the laboratory preparation of HNO_3, its properties and uses; (xvii) specify the properties of N_2O, NO, NO_2 gases.

TOPICS/CONTENTS/NOTES	OBJECTIVES
The nitrogen cycle. (e) Carbon: (i) Allotropes: Uses and properties (ii) Carbon (IV) oxide: Laboratory preparation, properties and uses. Action of heat on trioxocarbonate (IV) salts and test for CO_3^{2-} (iii) Carbon (II) oxide: Laboratory preparation, properties including its effect on blood; sources of carbon (II) oxide to include charcoal, fire and exhaust fumes. (iv) Coal: Different types, products obtained from destructive distillation of wood and coal. (v) Coke: Gasification and uses. Manufacture of synthesis gas and uses.	(xviii) examine the relevance of nitrogen cycle to the environment; (xix) identify allotropes of carbon; (xx) predict reagents for the laboratory preparation of CO_2; (xxi) specify the properties of CO_2 and its uses; (xxii) determine the reagents for the laboratory preparation of CO; (xxiii) predict the effects of CO on human; (xxiv) identify the different forms of coal; (xxv) determine their uses; (xxvi) specify the products of the destructive distillation of wood and coal; and (xxvii) specify the uses of coke and synthesis gas.
16. Metals and their compounds (a) General properties of metals (b) Alkali metals e.g. sodium (i) Sodium hydroxide:- Production by electrolysis of brine, its action on aluminium, zinc and lead ions. Uses including precipitation of metallic hydroxides. (ii) Sodium trioxocarbonate (IV) and sodium hydrogen trioxocarbonate (IV): Production by Solvay process, properties and uses, e.g. Na_2CO_3 in the manufacture of glass. (iii) Sodium chloride: its occurrence in sea water and uses, the economic importance of sea water and the recovery of sodium chloride. (c) Alkaline-earth metals, e.g. calcium; calcium oxide, calcium hydroxide and calcium trioxocarbonate (IV); Properties and uses. Preparation of calcium oxide from sea shells, the chemical composition of cement and the setting of mortar. Test for Ca^{2+}.	Candidates should be able to: (i) specify the general properties of metals; (ii) determine the method of extraction suitable for each metal; (iii) relate the methods of extraction to the properties for the metals; (iv) compare the chemical reactivities of the metals; (v) specify the uses of the metals; (vi) determine specific test for metallic ions; (vii) determine the process for the production of the compounds of these metals; (viii) compare the chemical reactivities of the compounds; (ix) specify the uses of these compounds; (x) specify the chemical composition of cement.

TOPICS/CONTENTS/NOTES	OBJECTIVES
(c) Aluminium Purification of bauxite, electrolytic extraction, properties and uses of aluminium and its compounds. Test for $A1^{3+}$	(xi) describe the method of purification of bauxite;
(e) Tin Extraction from its ores. Properties and uses.	(xii) specify the ores of tin; (xiii) relate the method of extraction to its properties; (xiv) specify the uses of tin;
(f) Metals of the first transition series. Characteristic properties: (i) electron configuration (ii) oxidation states (iii) complex ion formation (iv) formation of coloured ions (v) catalysis	(xv) identify the general properties of the first transition metals; (xvi) deduce reasons for the specific properties of the transition metals; (xvii) determine the IUPAC names of simple transition metal complexes;
(g) Iron Extraction from sulphide and oxide ores, properties and uses, different forms of iron and their properties and advantages of steel over iron. Test for Fe^{2+} and Fe^{3+}	(xviii) determine the suitable method of extraction of iron; (xix) specify the properties and uses of iron; (xx) identify the different forms of iron, their compositions, properties and uses;
(h) Copper Extraction from sulphide and oxide ores, properties and uses of copper. Preparation and uses of copper (II) Tetraoxosulphate (VI). Test for Cu^{2+}	(xxi) identify the appropriate method of extraction of copper from its compounds; (xxii) relate the properties of copper and its compound to their uses; (xxiii) specify the method for the preparation of $CuSO_4$;
(i) Alloy Steel, stainless steel, brass, bronze, type-metal, duralumin, soft solder, permallory and alnico (constituents and uses only).	(xxiv) specify the constituents and uses of the various alloys mentioned; and (xxv) compare the properties and uses of alloys to pure metals.
17. Organic Compounds	Candidates should be able to:
An introduction to the tetravalency of carbon, the general formula, IUPAC nomenclature and the determination of empirical formula of each class of the organic compounds mentioned below.	(i) derive the name of organic compounds from their general formulae; (ii) relate the name of a compound to its structure; (iii) relate the tetravalency of carbon to its ability to form chains of compound (catenation);
(a) Aliphatic hydrocarbons	(iv) classify compounds according to their functional groups;
(i) Alkanes Homologous series in relation to physical properties, substitution reaction and a few examples and uses of halogenated	(v) derive empirical formula and molecular formula, from given data; (vi) relate structure/functional groups to specific properties; (vii) derive various isomeric forms from a given

TOPICS/CONTENTS/NOTES	OBJECTIVES
products. Isomerism: structural only (examples on isomerism should not go beyond six carbon atoms). Petroleum: composition, fractional distillation and major products; cracking and reforming, Petrochemicals – starting materials of organic syntheses, quality of petrol and meaning of octane number.	formula; (viii) distinguish between the different types of isomerism; (ix) classify the various types of hydrocarbons; (x) distinguish each class of hydrocarbons by their properties; (xi) specify the uses of various hydrocarbons; (xii) identify crude oil as a complex mixture of hydrocarbons; (xiii) relate the fractions of hydrocarbons to their properties and uses; (xiv) relate transformation processes to quality improvement of the fractions;
(ii) Alkenes Isomerism: structural and geometric isomerism, additional and polymerization reactions, polythene and synthetic rubber as examples of products of polymerization and its use in vulcanization.	(xv) distinguish between various polymerization processes; (xvi) specify the process involved in vulcanization;
(iii) Alkynes Ethyne – production from action of water on carbides, simple reactions and properties of ethyne.	(xvii) specify chemical test for terminal alkynes;
(b) Aromatic hydrocarbons e.g. benzene - structure, properties and uses.	(xviii) distinguish between aliphatic and aromatic hydrocarbons;
(c) Alkanols Primary, secondary, tertiary – production of ethanol by fermentation and from petroleum by-products. Local examples of fermentation and distillation, e.g. gin from palm wine and other local sources and glycerol as a polyhydric alkanol. Reactions of OH group – oxidation as a distinguishing test among primary, secondary and tertiary alkanols (Lucas test).	(xix) relate the properties of benzene to its structure; (xx) compare the various classes of alkanols; (xxi) determine the processes involved in ethanol production; (xxii) examine the importance of ethanol as an alternative energy provider; (xxiii) distinguish the various classes of alkanols;
(d) Alkanals and alkanones. Chemical test to distinguish between alkanals and alkanones.	(xxiv) differentiate between alkanals and alkanones;
(e) Alkanoic acids. Chemical reactions; neutralization and esterification, ethanedioic (oxalic) acid as an example of a dicarboxylic acid and benzene carboxylic acid as an example of an aromatic acid.	(xxv) compare the various types of alkanoic acids;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(f) Alkanoates Formation from alkanoic acids and alkanols – fats and oils as alkanoates. Saponification: Production of soap and margarine from alkanoates and distinction between detergents and soaps.	(xxvi) identify natural sources of alkanoates; (xxvii) specify the methods for the production of soap, detergent and margarine; (xxviii) distinguish between detergent and soap;
(g) Amines (Alkanamines) Primary, Secondary, and tertiary	(xxix) compare the various classes of alkanamine;
(h) Carbohydrates Classification – mono-, di- and polysaccharides; composition, chemical tests for simple sugars and reaction with concentrated tetraoxosulphate (VI) acid. Hydrolysis of complex sugars e.g. cellulose from cotton and starch from cassava, the uses of sugar and starch in the production of alcoholic beverages, pharmaceuticals and textiles.	(xxx) identify the natural sources of carbohydrates; (xxxi) compare the various classes of carbohydrates; (xxxii) infer the products of hydrolysis and dehydration of carbohydrates; (xxxiii) determine the uses of carbohydrates; (xxxiv) specify the tests for simple sugars;
(i) Proteins: Primary structures, hydrolysis and tests (Ninhydrin, Biuret, Millon's and xanthoproteic) Enzymes and their functions.	(xxxv) identify the basic structure of proteins; (xxxvi) specify the methods and products of hydrolysis; (xxxvii) specify the various tests for proteins;
(j) Polymers: Natural and synthetic rubber; addition and condensation polymerization. Methods of preparation, examples and uses. Thermoplastic and thermosetting plastics.	(xxxviii) distinguish between natural and synthetic polymers; (xxxix) differentiate between addition and condensation polymerization processes; (xl) classify natural and commercial polymers and their uses; and (xli) distinguish between thermoplastics and thermosetting plastics.
18. Chemistry and Industry Chemical industries: Types, raw materials and relevance; Biotechnology.	Candidates should be able to: (i) classify chemical industries in terms of products; (ii) identify raw materials for each industry; (iii) distinguish between fine and heavy chemicals; (iv) enumerate the relevance of each of these industries; and (v) relate industrial processes to biotechnology.

RECOMMENDED TEXTS

1. Ababio, O. Y. (2009).*New School Chemistry for Senior Secondary Schools* (Fourth edition), Onitsha: Africana FIRST Publishers Limited.

2. Bajah, S.T.; Teibo, B. O., Onwu, G.; and Obikwere, A. Book 1 (1999).*Senior Secondary Chemistry*, Books 2 and 3 (2000). Lagos: Longman.

3. Ojokuku, G. O. (2012). *Understanding Chemistry for Schools and Colleges*, (Revised Edition), Zaria: Press-On Chemresources.

4. Odesina, I. A. (2008).*Essential: Chemistry for Senior Secondary Schools*,*(2nd Edition)*,Lagos: Tonad Publishers Limited.

5. Uche, I. O. Adenuga, I. J. and Iwuagwu, S. L. (2003).*Countdown to WASSCE/SSCE, NECO, JME Chemistry*, Ibadan: Evans.

MATHEMATICS

GENERAL OBJECTIVES

The aim of the Unified Tertiary Matriculation Examination (UTME) syllabus in Mathematics is to prepare the candidates for the Board's examination. It is designed to test the achievement of the course objectives which are to:

(1) acquire computational and manipulative skills;
(2) develop precise, logical and formal reasoning skills;
(3) develop deductive skills in interpretation of graphs, diagrams and data;
(4) apply mathematical concepts to resolve issues in daily living.

This syllabus is divided into five sections:

I. Number and Numeration
II. Algebra
III. Geometry/Trigonometry
IV. Calculus
V. Statistics

DETAILED SYLLABUS

TOPICS/CONTENTS/NOTES	OBJECTIVES
SECTION I: NUMBER AND NUMERATION **1. Number bases:** (a) operations in different number bases from 2 to 10; (b) conversion from one base to another including fractional parts.	Candidates should be able to: i. perform four basic operations $(x, +, -, \div)$; ii. convert one base to another; iii. perform operations in modulo arithmetic.
2. Fractions, Decimals, Approximations and Percentages: (a) fractions and decimals; (b) significant figures; (c) decimal places; (d) percentage errors; (e) simple interest; (f) profit and loss percent; (g) ratio, proportion and rate; (h) shares and valued added tax (VAT).	Candidates should be able to: i. perform basic operations $(x, +, -, \div)$ on fractions and decimals; ii. express to specified number of significant figures and decimal places; iii. calculate simple interest, profit and loss per cent; ratio proportion, rate and percentage error; iv. solve problems involving share and VAT.
3. Indices, Logarithms and Surds: (a) laws of indices; (b) equations involving indices; (c) standard form; (d) laws of logarithm;	Candidates should be able to: i. apply the laws of indices in calculation; ii. establish the relationship between indices and logarithms in solving problems; iii. solve equations involving indices; iv. solve problems in different bases in logarithms;

TOPICS/CONTENTS/NOTES	OBJECTIVES
(e) logarithm of any positive number to a given base; (f) change of bases in logarithm and application; (g) relationship between indices and logarithm; (h) Surds.	v. simplify and rationalize surds; vi. perform basic operations on surds.
4. Sets: (a) types of sets (b) algebra of sets (c) Venn diagrams and their applications.	Candidates should be able to: i. identify types of sets, i.e. empty, universal, complements, subsets, finite, infinite and disjoint sets; ii. solve problems involving cardinality of sets; iii. solve set problems using symbols; iv. use Venn diagrams to solve problems involving not more than 3 sets.
SECTION II: ALGEBRA	
1. Polynomials: (a) change of subject of formula; (b) multiplication and division of polynomials; (c) factorization of polynomials of degree not exceeding 3; (d) roots of polynomials not exceeding degree 3; (e) factor and remainder theorems; (f) simultaneous equations including one linear one quadratic; (g) graphs of polynomials of degree not greater than 3.	Candidates should be able to: i. find the subject of the formula of a given equation; ii. apply factor and remainder theorem to factorize a given expression; iii. multiply, divide polynomials of degree not more than 3 and determine values of defined and undefined expression; iv. factorize by regrouping difference of two squares, perfect squares and cubic expressions; etc. v. solve simultaneous equations – one linear, one quadratic; vi. interpret graphs of polynomials including applications to maximum and minimum values.
2. Variation: (a) direct; (b) inverse; (c) joint; (d) partial; (e) percentage increase and decrease.	Candidates should be able to: i. solve problems involving direct, inverse, joint and partial variations; ii. solve problems on percentage increase and decrease in variation.
3. Inequalities: (a) analytical and graphical solutions of linear inequalities; (b) quadratic inequalities with integral roots only.	Candidates should be able to: i. solve problems on linear and quadratic inequalities; ii. interpret graphs of inequalities.
4. Progression: (a) nth term of a progression (b) sum of A. P. and G. P.	Candidates should be able to: i. determine the nth term of a progression; ii. compute the sum of A. P. and G.P; iii. sum to infinity of a given G.P.

TOPICS/CONTENTS/NOTES	OBJECTIVES
5. Binary Operations: (a) properties of closure, commutativity, associativity and distributivity; (b) identity and inverse elements (simple cases only).	Candidates should be able to: i. solve problems involving closure, commutativity, associativity and distributivity; ii. solve problems involving identity and inverse elements.
6. Matrices and Determinants: (a) algebra of matrices not exceeding 3 x 3; (b) determinants of matrices not exceeding 3 x 3; (c) inverses of 2 x 2 matrices; [excluding quadratic and higher degree equations].	Candidates should be able to: i. perform basic operations $(x, +, -, \div)$ on matrices; ii. calculate determinants; iii. compute inverses of 2 x 2 matrices.
SECTION III: GEOMETRY AND TRIGONOMETRY	
1. Euclidean Geometry: (a) Properties of angles and lines (b) Polygons: triangles, quadrilaterals and general polygons; (c) Circles: angle properties, cyclic quadrilaterals and intersecting chords; (d) construction.	Candidates should be able to: i. identify various types of lines and angles; ii. solve problems involving polygons; iii. calculate angles using circle theorems; iv. identify construction procedures of special angles, e.g. 30º, 45º, 60º, 75º, 90º etc.
2. Mensuration: (a) lengths and areas of plane geometrical figures; (b) lengths of arcs and chords of a circle; (c) Perimeters and areas of sectors and segments of circles; (d) surface areas and volumes of simple solids and composite figures; (e) the earth as a sphere: longitudes and latitudes.	Candidates should be able to: i. calculate the perimeters and areas of triangles, quadrilaterals, circles and composite figures; ii. find the length of an arc, a chord, perimeters and areas of sectors and segments of circles; iii. calculate total surface areas and volumes of cuboids, cylinders. cones, pyramids, prisms, spheres and composite figures; iv. determine the distance between two points on the earth's surface.
3. Loci: locus in 2 dimensions based on geometric principles relating to lines and curves.	Candidates should be able to: identify and interpret loci relating to parallel lines, perpendicular bisectors, angle bisectors and circles.
4. Coordinate Geometry: (a) midpoint and gradient of a line segment; (b) distance between two points; (c) parallel and perpendicular lines; (d) equations of straight lines.	Candidates should be able to: i. determine the midpoint and gradient of a line segment; ii. find the distance between two points;

TOPICS/CONTENTS/NOTES	OBJECTIVES
	iii. identify conditions for parallelism and perpendicularity; iv. find the equation of a line in the two-point form, point-slope form, slope intercept form and the general form.
5. Trigonometry: (a) trigonometrical ratios of angles; (b) angles of elevation and depression; (c) bearings; (d) areas and solutions of triangle; (e) graphs of sine and cosine; (f) sine and cosine formulae.	Candidates should be able to: i. calculate the sine, cosine and tangent of angles between $-360^{o} \leq \Theta \leq 360^{o}$; ii. apply these special angles, e.g. 30^{o}, 45^{o}, 60^{o}, 75^{o}, 90^{o}, 105^{0}, 135^{o} to solve simple problems in trigonometry; iii. solve problems involving angles of elevation and depression; iv. solve problems involving bearings; v. apply trigonometric formulae to find areas of triangles; vi. solve problems involving sine and cosine graphs.
SECTION IV: CALCULUS	
1. Differentiation: (a) limit of a function (b) differentiation of explicit algebraic and simple trigonometrical functions – sine, cosine and tangent.	Candidates should be able to: i. find the limit of a function ii. differentiate explicit algebraic and simple trigonometrical functions.
2. Application of differentiation: (a) rate of change; (b) maxima and minima.	Candidates should be able to: solve problems involving applications of rate of change, maxima and minima.
3. Integration: (a) integration of explicit algebraic and simple trigonometrical functions; (b) area under the curve.	Candidates should be able to: i. solve problems of integration involving algebraic and simple trigonometric functions; ii. calculate area under the curve (simple cases only).
SECTION V: STATISTICS	
1. Representation of data: (a) frequency distribution; (b) histogram, bar chart and pie chart.	Candidates should be able to: i. identify and interpret frequency distribution tables; ii. interpret information on histogram, bar chat and pie chart.
2. Measures of Location: (a) mean, mode and median of ungrouped and grouped data – (simple cases only); (b) cumulative frequency.	Candidates should be able to: i. calculate the mean, mode and median of ungrouped and grouped data (simple cases only);

TOPICS/CONTENTS/NOTES	OBJECTIVES
	ii. use ogive to find the median, quartiles and percentiles.
3. Measures of Dispersion: range, mean deviation, variance and standard deviation.	Candidates should be able to: calculate the range, mean deviation, variance and standard deviation of ungrouped and grouped data.
4. Permutation and Combination: (a) Linear and circular arrangements; (b) Arrangements involving repeated objects.	Candidates should be able to: solve simple problems involving permutation and combination.
5. **Probability:** (a) experimental probability (tossing of coin, throwing of a dice etc); (b) Addition and multiplication of probabilities (mutual and independent cases).	Candidates should be able to: solve simple problems in probability (including addition and multiplication).

RECOMMENDED TEXTS

Adelodun A. A. (2000) *Distinction in Mathematics: Comprehensive Revision Text, (3rd Edition)* Ado –Ekiti: FNPL.

Anyebe, J. A. B. (1998**)** *Basic Mathematics for Senior Secondary Schools and Remedial Students in Higher Institutions*, Lagos: Kenny Moore.

Channon, J. B. Smith, A. M. (2001) *New General Mathematics for West Africa SSS 1 to 3*, Lagos: Longman.

David –Osuagwu, M. et al. (2000) *New School Mathematics for Senior Secondary Schools,* Onitsha: Africana - FIRST Publishers.

Egbe. E et al (2000) *Further Mathematics, Onitsha*: Africana – FIRST Publishers

Ibude, S. O. et al.. (2003) *Algebra and Calculus for Schools and Colleges:* LINCEL Publishers.

Tuttuh – Adegun M. R. et al. (1997) *Further Mathematics Project Books 1 to 3*, Ibadan: NPS Educational

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BIOLOGY

GENERAL OBJECTIVES

The aim of the Unified Tertiary Matriculation Examination (UTME) syllabus in Biology is to prepare the candidates for the Board's examination. It is designed to test their achievement of the course objectives, which are to:

1. demonstrate sufficient knowledge of the concepts of the diversity, interdependence and unity of life;
2. account for continuity of life through reorganization, inheritance and evolution;
3. apply biological principles and concepts to everyday life, especially to matters affecting living things, individual, society, the environment, community health and the economy.

DETAILED SYLLABUS

A: VARIETY OF ORGANISMS

TOPICS / CONTENTS/ NOTES	OBJECTIVES
1. Living organisms: a. Characteristics b. Cell structure and functions of cell components c. Level of organization i. Cell e.g. *euglena and paramecium*, ii. Tissue e.g. epithelial tissues and hydra iii. Organ e.g. onion bulb iv. Systems e.g. reproductive, digestive and excretory v. Organisms e.g. *Chlamydomonas*	Candidates should be able to: i. differentiate between the characteristics of living and non-living things. ii. identify the structures of plant and animal cells. iii. analyse the functions of the components of plant and animal cells. iv. compare and contrast the structure of plant and animal cells. v. trace the levels of organization among organisms in their logical sequence in relation to the five levels of organization of living organisms.
2. Evolution among the following: a. Monera (prokaryotes), e.g. bacteria and blue green algae. b. Protista (protozoans and protophyta), e.g. *Amoeba*, *Euglena* and *Paramecium.* c. Fungi, e.g. *mushroom* and *Rhizopus*. d. Plantae (plants) i. Thallophyta (e.g. *Spirogyra*). ii. Bryophyta (mosses and liverworts) e.g. *Brachmenium* and *Merchantia*.	Candidates should be able to: i. analyse external features and characteristics of the listed organisms. ii. apply the knowledge from (i) above to demonstrate increase in structural complexity. iii. trace the stages in the life histories of the listed organisms. iv. apply the knowledge of the life histories to demonstrate gradual transition from life in water to life on land. v. trace the evolution of the listed plants.

iii. Pteridophyta (ferns) e.g. *Dryopteris*.	
iv. Spermatophyta (Gymnospermae and Angiospermae) - Gymnosperms e.g. Cycads and conifers. - Angiosperms (monocots, e.g. maize; dicots, e.g. water leaf)	
e. Animalia (animals) i. Invertebrates - coelenterate e.g. *Hydra* - Platyhelminthes flatworms e.g. *Taenia* - Nematoda (roundworms) - Annelida e.g. earthworm - Arthropoda e.g. mosquito, cockroach, housefly, bee, butterfly - Mollusca e.g. snails ii. Multicellular animals (vertebrates) - Pisces (cartilaginous and bony fish) - Amphibia e.g. toads and frogs - Reptilia e.g. lizards, snakes and turtles - Aves (birds) - Mammalia (mammals)	Candidates should be able to: i. trace the advancement of the invertebrate animals. ii. determine the economic importance of the insects studied. iii. assess their values to the environment. iv. trace the advancement of multi-cellular animals. v. determine their economic importance.
3. Structural/functional and behavioural adaptations of organisms:	Candidates should be able to: i. describe how the various structures, functions and behaviour adapt these organisms to their environment, and way of life.
a. adaptive colouration and its functions	ii.Categorize countershading in fish, toads, snakes and warning colouration in mushrooms.
b. Behavioural adaptations in social animals	iii. Differentiate various castes in social insects like termites and their functions in their colony hive. iv. Account for basking in lizards, territorial behavour of other animals under unfavourable conditions (hibernation and aestivation).
c. Structural adaptations in organisms	i. account for adaptation in organisms with respect to the following: - Obtaining food (beaks and legs of birds, mouthparts of insects, especially mosquito, butterfly and moth.) - Protection and defence (stick insects, praying mantis and toad). - Securing mates (redhead male and female Agama lizards, display of feathers by birds). - Regulating body temperature (skin, feathers and hairs) - Conserving water (spines in plants and scales in mammals).

B: FORM AND FUNCTIONS

TOPICS / CONTENTS/ NOTES	OBJECTIVES
1. Internal structure of plants and animals	Candidates should be able to:
a. Internal structure of a flowering plant i. Root ii. Stem iii. Leaf	i. identify the transverse sections of these organs. ii. relate the structure of these organs to their functions. iii. identify supporting tissues in plants (collenchyma) sclerenchyma, xylem and phloem fibres) iv. describe the distribution of supporting tissues in roots, stem and leaf
b. Internal structure of a mammal	v. examine the arrangement of the mammalian internal organs. vi. describe the appearance and position of the digestive, reproductive and excretory organs.
2. Nutrition	Candidates should be able to:
a. Modes of nutrition i. Autotrophic ii. Heterotrophic	i. compare autotrophic and heterotrophic modes of nutrition. ii. provide examples from both flowering and non- flowering plants. iii. compare the photosynthetic and chemosynthetic modes of nutrition;
b. Types of Nutrition	iv. differentiate the following examples of heterotrophic feeding: - holozoic (sheep and man) - Parasitic (*roundworm*, *tapeworm* and *Loranthus*) - saprophytic (*Rhizopus* and *mushroom*) - carnivorous plants (sundew and bladderwort) - determine their nutritional value.
c. Plant nutrition i. Photosynthesis ii. Chemosynthesis iii. Mineral requirements (macro and micro-nutrients)	v. differentiate the light and dark reactions, of photosynthesis. vi. determine the necessity of light, carbon (IV) oxide and chlorophyll in photosynthesis. vii. detect the presence of starch in a leaf as an evidence of photosynthesis. viii. identify macro-and micro-elements required by plants. ix. recognise the deficiency symptoms of nitrogen, phosphorous and potassium.
d. Animal nutrition i. Classes of food substances; carbohydrates, proteins, fats and oils, vitamins, mineral salts and water	x. indicate the sources of the various classes of food; xi. determine the nutritional value of food xii. relate the importance and deficiency (e.g. scurvy, rickets, kwashiorkor etc.) of each class of food; xiii. determine the importance of a balanced diet.
ii. Food tests (e.g. starch, reducing sugar, protein, oil, fat etc.)	xiv. detect the presence of a food type from the result of a given experiment.
iii. The mammalian tooth (structures, types and functions)	xv. describe the structure of a typical mammalian tooth xvi. differentiate the types of mammalian tooth and relate their structures to their functions. xvii. compare the dental formulae of man, sheep and dog.
iv. Mammalian alimentary canal	xviii. relate the structure of the various components of the alimentary canal and its accessory organs (liver, pancreas and gall bladder) to their functions. xix. identify the general characteristics of digestive enzymes
v. Nutrition process (ingestion, digestion, absorption, and assimilation of digested food).	xx. associate enzymes with digestion of carbohydrates, proteins and fats and xxi. determine the end products of these classes of food.

3. Transport a. Need for transportation b. Materials for transportation (Excretory products, gases, manufactured food, digested food, nutrient, water and hormones) c. Channels for transportation i. Mammalian circulatory system (heart, arteries, vein and capillaries) ii Plant vascular system (phloem and xylem) d. Media and processes of mechanism for transportation.	Candidates should be able to: i. determine the relationship between increase in size and complexity; and the need for the development of a transport system in plants and animals. ii. determine the sources of materials and the forms in which they are transported. iii. describe the general circulatory system iv. compare specific functions of the hepatic portal vein, the pulmonary vein and artery, aorta, the renal artery and vein. v. identify the organs of the plant vascular system. vi. understand the specific functions of the phloem and xylem. vii. identify media of transportation (e.g. cytoplasm, cell sap, body fluid, blood and lymph) viii. state the composition and functions of blood and lymph ix. describe diffusion, osmosis, plasmolysis and turgidity as mechanisms of transportation in organisms. x. compare the various mechanisms of open circulatory systems in animal, transpiration pull, root pressure and active transport as mechanisms of transportation in plants.
4. Respiration a. Respiratory organs and surfaces b. The mechanism of gaseous exchange in: i. Plants ii. Animals c. Aerobic respiration d. Anaerobic respiration	Candidates should be able to: i. explain the significance of respiration; ii. describe a simplified outline of the chemical processes involved in glycolysis and krebs cycle with reference to ATP production iii deduce gaseous exchange and products, exchange and production of heat energy during respiration from experimental set up. iv. describe the following respiratory organs and surfaces with organisms in which they occur; body surface, gill, trachea, lungs, stomata and lenticel. v. describe the mechanism for the opening and closing of the stomata vi. determine respiratory mechanisms in plants and animals. vii. examine the role of oxygen in the liberation of energy for the activities of the living organisms viii. explain the effect of insufficient supply of oxygen to the muscles. ix. use yeast cells and sugar solution to demonstrate the process of fermentation. x. state the economic importance of yeasts.
5. Excretion a. Types of excretory structures: contractile vacuole, flame cell, nephridium, Malpighian tubule, kidney, stoma and lenticel. b. Excretory mechanisms: i. Kidneys ii. lungs iii. skin c. Excretory products of plants	Candidates should be able to: i. define the meaning and state the significance of excretion ii. relate the characteristics of each structure with functions. iii. relate the structure of the kidneys to the excretory and osmo-regulatory functions. iv. identify the functions and excretory products of the lungs and the skin. v. deduce the economic importance of the excretory products of plants e.g. carbon (IV) oxide, oxygen, tannins, resins, gums, mucilage, alkaloids etc.

6. Support and movement	Candidates should be able to:
a. Tropic, tactic, nastic and sleep movements in plants	i. determine the need for support and movement in organisms ii. identify supporting tissues in plants (collenchyma, sclerenchyma, xylem and phloem fibres) iii. describe the distribution of supporting tissues in root, stem and leaf. iv. relate the response of plants to the stimuli of light, water, gravity and touch v. identify the regions of growth in roots and shoots and the roles of auxins in tropism.
b. supporting tissues in animals	vi. relate the location of chitin, cartilage and bone to their supporting function.
c. Types and functions of the skeleton i. Exoskeleton ii. Endoskeleton iii. Functions of the skeleton in animals	vii. relate the structure and the general layout of the mammalian skeleton to their supportive, locomotive and respiratory function. viii. differentiate types of joints using appropriate examples. ix. apply the protective, supportive, locomotive and respiratory functions of the skeleton to the well being of the animal.
7. Reproduction	Candidates should be able to:
a. Asexual reproduction i. Fission (e.g. *Paramecium*) ii. Budding (e.g. yeast) iii. Natural vegetative propagation iv. Artificial vegetative propagation	i. differentiate between asexual and sexual reproduction ii. apply natural vegetative propagation in crop production and multiplication. iii. apply grafting, budding and layering in agricultural practices.
b. Sexual reproduction in flowering plants i. Floral parts and their functions ii. Pollination and fertilization iii. products of sexual reproduction	iv. relate parts of flower to their functions and reproductive process. v. state the advantages of cross pollination. vi. deduce the different types of placentation that develop into simple, aggregate, multiple and succulent fruits. vii. differentiate between male and female reproductive organs. viii. relate their structure and function to the production of offspring.
c. Reproduction in mammals i. Structures and functions of the male and female reproductive organs ii. Fertilization and development. (Fusion of gametes)	ix. describe the fusion of gametes as a process of fertilization. x. relate the effects of the mother's health, nutrition and indiscriminate use of drugs on the developmental stages of the embryo up to birth. xi. explain the modern methods of regulating reproduction on e.g. invitro fertilization and birth control
8. Growth	Candidates should be able to:
a. Meaning of growth	i. apply the knowledge of the conditions necessary for germination on plant growth.
b. Germination of seeds and condition necessary for germination of seeds.	ii. differentiate between epigeal and hypogeal germination.
9. Co-ordination and control	Candidates should be able to:
a. Nervous coordination: i. the components, structure and functions of the central nervous system ii. The components and functions of the peripheral nervous system iii. Mechanism of transmission of impulses iv. Reflex action	i. apply the knowledge of the structure and function of the central nervous system in the coordination of body functions in organisms. ii. illustrate reflex actions such as blinking of the eyes, knee jerk etc. iii. differentiate between reflex and voluntary actions as well as conditioned reflexes such as salivation, riding a bicycle and

b. The sense organs i. Skin (tactile) ii. Nose (olfactory) iii. Tongue (taste) iv. Eye (sight) v. Ear (auditory) c. Hormonal control i. animal hormonal system (Pituitary, thyroid, parathyroid, adrenal gland, pancreas, gonads) ii. Plant hormones (phytohormones) d. Homeostasis i. Body temperature regulation ii. Salt and water regulation	swimming. iv. relate the listed sense organs with their functions. v. apply the knowledge of the structure and functions of these sense organs in detecting and correcting their defects. vi. state the location of the listed endocrine glands in animals. vii. relate the hormone produced by each of these glands to their functions. viii. examine the effects of various phytohormones (e.g. auxins, gibberellin, cytokinin, and ethylene) on growth, tropism, flowering, fruit ripening and leaf abscission. ix. relate the function of hormones in homeostasis.

C: ECOLOGY

TOPICS - CONTENTS - NOTES	OBJECTIVES
1. Factors affecting the distribution of Organisms i. Abiotic ii. Biotic	Candidates should be able to: i. relate the effects of temperature; rainfall, relative humidity, wind speed and direction, altitude, salinity, turbidity, pH and edaphic (soil) conditions on the distribution of organisms. ii. use appropriate equipment (secchi disc, thermometer, rain gauge) to measure abiotic factors. iii. describe how the activities of plants/animals (particularly human) affect the distribution of organisms.
2. Symbiotic interactions of plants and animals (a) Energy flow in the ecosystem: food chains, food webs and trophic levels. (b) Nutrient cycling in nature. i. carbon cycle ii. water cycle iii. Nitrogen cycle	Candidates should be able to: i. determine appropriate examples of symbiosis, parasitism, saprophytism, commensalism, mutualism, amensalism, competition, predation and cooperation among organisms. ii. explain the distribution of organisms with food chains and food webs in particular habitats. iii. define chains and webs iv. describe the carbon cycle and its significance including the balance of atmospheric oxygen and carbon (IV) oxide and global warming. v. assess the effects of water cycle on other nutrient cycles. vi. relate the roles of bacteria and leguminous plants in the cycling of nitrogen.
3. Natural Habitats (a) Aquatic (e.g. ponds, streams, lakes, seashores and mangrove swamps)	Candidates should be able to: i. associate plants and animals with each of these habitats.

(b) Terrestrial/arboreal (e.g. tree-tops, abandoned farmland or a dry grassy (savanna) field, and burrow or hole.	ii. relate adaptive features to the habitats in which organisms live.
4. Local (Nigerian) Biomes a. Tropical rainforest b. Guinea savanna (southern and northern) c. Sudan Savanna d. Desert e. Highlands of montane forests and grasslands of the Obudu -, Jos -, Mambilla - Plateaus.	Candidates should be able to: i. locate biomes in regions ii. apply the knowledge of the features of the listed local biomes in determining the characteristics of different regions of Nigeria.
5. **The Ecology of Populations** (a) Population density and overcrowding.	Candidates should be able to: i. determine the reasons for rapid changes in human population and the consequences of overcrowding. ii. compute/calculate density as the number of organisms per unit area.
(b) Adaptation for survival i. Factors that bring about competition	iii. Relate increase in population, diseases, shortage of food and space with intra- and inter-specific competition.
ii. Intra and inter-specific competition	iv. Determine niche differentiation as a means of reducing intra-specific completion. v. Relate competition to succession.
iii. Relationship between competition and succession.	vi. deduce the effect of these factors on the size of population.
(c) Factors affecting population sizes: i. Biotic (food, pest, disease, predation, competition and reproductive ability).	vii. determine the interactions between biotic and abiotic factors, (e.g. drought or scarcity of water which leads to food shortage and lack of space which causes increase in disease rates).
ii. Abiotic (temperature, space, light, rainfall, topography, pressure, pH) etc.	viii. trace the sequence in succession to the climax stage of stability in plant population.
(d) Ecological succession i. primary succession ii. secondary succession	
6. SOIL a. Characteristics of different types of soil (sandy, loamy, clayey) i. soil structure ii. porosity, capillarity and humus content	Candidates should be able to: i. identify physical properties of different soil types based on simple measurement of particle size, porosity or water retention ability. ii. determine the amounts of air, water, humus and capillarity in different soil types experimentally. iii. relate soil characteristics, types and components to the healthy growth of plants
b. Components of the soil i. inorganic ii. organic iii. soil organisms iv. soil air v. soil water	iv. relate such factors as loss of inorganic matter, compaction, leaching, erosion of the top soil and repeated cropping with one variety. v. apply the knowledge of the practice of contour ridging, terracing, mulching, poly-cropping, strip-cropping, use of organic and inorganic fertilizers, crop rotation, shifting cultivation, etc. to enhance soil conservation.
c. Soil fertility i. loss of soil fertility ii. renewal and maintenance of soil fertility	

7. Humans and Environment (a) Diseases: (i) Common and endemic diseases ii. Easily transmissible diseases and disease syndrome such as: - poliomyelitis - cholera - tuberculosis - sexually transmitted disease/syndrome (gonorrhea, syphilis, AIDS, etc.) b. Pollution and its control (i) Sources, types, effects and methods of control. (ii) Sanitation and sewage c. Conservation of Natural Resources d. Game reserves and National parks	Candidates should be able to: i. identify ecological conditions that favour the spread of common endemic and potentially epidemic diseases e.g. malaria, meningitis, drancunculiasis, schistosomiasis, onchocerciasis, typhoid fever and cholera. ii. relate the biology of the vector or agent of each disease with its spread and control iii. use the knowledge of the causative organisms, mode of transmission and symptoms of the listed diseases to their prevention - treatment - control iv. apply the principles of inoculation and vaccination on disease prevention. v. categorize pollution into air, water and soil vi. relate the effects of common pollutants to human health and environmental degradation. vii. determine the methods by which each pollutant may be controlled. viii. explain the importance of sanitation with emphasis on solid waste, sewage disposal, community health and personal hygiene. ix. assess the roles and functions of international and national health agencies e.g. World Health Organization (WHO), United Nations International Children Emergency Fund (UNICEF), International Red Cross Society (IRCS) and the ministries of health and environment. x. apply the various methods of conservation of both the renewable and non-renewable natural resources for the protection of our environment for present and future generations. xi. outline the benefits of conserving natural resources, prevention of desertification. xii. identify the bodies responsible for the conservation of resources at the national and international levels e.g. Nigerian Conservation Foundation (NCF), Federal Ministry of Environment, Nigeria National Parks, World Wildlife Foundation (WWF), International Union for Conservation of Nature (IUCN), United Nations Environmental Programme (UNEP) and their activities. xiii identify and state the location and importance of game reserves and National parks in Nigeria

D: HEREDITY AND VARIATIONS

TOPICS - CONTENTS - NOTES	OBJECTIVES
(I) Variation In Population a. Morphological variations in the physical appearance of individuals. (i) size (height and weight) (ii) Colour (skin, eye, hair, coat of animals, scales and feathers).	Candidates should be able to: i. differentiate between continuous and discontinuous variations with examples. ii. relate the role of environmental conditions, habitat and the genetic constitution to variation. iii. measure heights and weights of pupils of the same age group iv. plot graphs of frequency distribution of the heights

(iii) Fingerprints	and weights. v. observe and record various colour patterns in some plants and animals.
b. Physiological variation (i) Ability to roll tongue (ii) Ability to taste phenylthiocarbamide (PTC) (iii) Blood groups	vi. apply classification of fingerprints in identity detection. vii. identify some specific examples of physiological variation among human population. viii. categorize people according to their physiological variation.
c. Application of discontinuous variation in crime detection, blood transfusion and determination of paternity.	ix. apply the knowledge of blood groups in blood transfusion and determination of paternity. x. use discontinuous variation in crime detection.
2. Heredity	Candidates should be able to:
a) Inheritance of characters in organisms (i) Heritable characters (ii) Non-heritable characters	i. determine heritable and non-heritable characters with examples.
b) Chromosomes – the basis of heredity	ii. illustrate simple structure of DNA
(i) Structure (ii) Process of transmission of hereditary characters from parents to offsprings.	iii. illustrate segregation of genes at meiosis and recombination of genes at fertilization to account for the process of transmission of characters from parents to offsprings.
c) Probability in genetics and sex determination.	iv. deduce that segregation of genes occurs during gamete formation and that recombination of genes at fertilization is random in nature.
d) Application of the principles of heredity in:	v. analyze data on cross-breeding experiments. vi. apply the principles of heredity in the production of new varieties of crops and livestock through cross-breeding.
i) Agriculture	vii. deduce advantages and disadvantages of out-breeding and in-breeding.
(ii) Medicine	viii. analyze elementarily the contentious issues of genetically modified organisms (GMO) and gene therapy and biosafety.
e) Sex – linked characters e.g. baldness, haemophilia, colour blindness, etc.	ix. apply the knowledge of heredity in marriage counselling with particular reference to blood grouping, sickle-cell anaemia and the Rhesus factors. x. describe the significance of using recombinant DNA materials in the production of important medical products such as insulin, interferon and enzymes. xi. identify characters that are sex linked.

E: EVOLUTION

TOPICS - CONTENTS - NOTES	OBJECTIVES
1. **Theories of evolution** a) Lamarck's theory b) Darwin's theory c) organic theory 2. **Evidence of evolution**	Candidates should be able to: i. relate organic evolution as the sum total of all adaptive changes that have taken place over a long period of time resulting in the diversity of forms, structures and functions among organisms. ii. explain the contributions of Lamarck and Darwin to the theory of evolution. iii. state the evidences in support of organic evolution iv. mention the evidences for evolution such as fossil records, comparative anatomy, physiology and embryology. v. trace evolutionary trends in plants and animals. vi. state the evidence of modern evolutionary theories such as genetic studies and the role of mutation.

RECOMMENDED TEXTS

Ndu, F.O. C. Ndu, Abun A. and Aina J.O. (2001) *Senior Secondary School Biology: Books 1 -3,* Lagos: Longman

Odunfa, S.A. (2001) *Essential of Biology*, Ibadan: Heinemann

Ogunniyi M.B. Adebisi A.A. and Okojie J.A. (2000) *Biology for Senior Secondary Schools: Books 1 – 3*, Macmillan

Ramalingam, S.T. (2018) *Modern Biology, SS Science Series*. *New Edition*, AFP

Stan. (2004) *Biology for Senior Secondary Schools*. *Revised Edition*, *Ibadan*: Heinemann

Stone R.H. and Cozens, A.B.C. (1982) *Biology for West African Schools*. Longman

Usua, E.J. (1997) *Handbook of practical Biology 2nd Edition*, University Press, Limited

Idodo – Umeh, G (2015) College Biology. Idodo – Umeh Publishers Ltd.

Micheal, M.C. (2018) Essential Biology for Senior Secondary Schools. TONAD Publishers Ltd.