



For Performance Measurement

**ZIMBABWE SCHOOL
EXAMINATIONS COUNCIL
(ZIMSEC)**

ADVANCED LEVEL SYLLABUS

**FOOD SCIENCE
9194**

EXAMINATION SYLLABUS FOR 2013-2017

Additional copies of the syllabus and specimen question paper booklets can be ordered from Zimsec.

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FOOD SCIENCE

PREAMBLE

This syllabus recognizes that Zimbabwe has an agro-based economy which endeavours to develop a sound processing industry, hence improving food security.

The syllabus enables students to develop a sound scientific background in Food Science, so that they can take up further studies in Food Chemistry, Food Microbiology, Nutrition and any other related fields of study.

The course will be covered in a period of two years. It is intended for students with a strong Chemistry background. Practical work is an integral part of the course and teachers should ensure that candidates undertake experimental work in an appropriate and safe environment.

The syllabus also requires a certain amount of investigative work. Candidates are required to complete an individual study which will be forwarded to ZIMSEC for assessment.

1. Aims

The syllabus aims to:

- 1.1 impart basic scientific concepts of Food Science.
- 1.2 develop scientific knowledge and understanding of the techniques and processes used in food production and the resultant changes thereof.
- 1.3 encourage innovativeness in product development.
- 1.4 promote an understanding of national and appreciation of international policies relating to the provision of a safe food supply.
- 1.5 develop investigative, analytical, problem solving and decision-making skills.
- 1.6 develop an appreciation of the environmental, cultural and socio-economic factors affecting food security.

2. Assessment Objectives

At the end of the course candidates should be able to:

- 2.1 demonstrate knowledge and understanding of commonly used terminology in Food Science and Nutrition.
- 2.2 demonstrate an understanding of fundamental aspects of Food Microbiology, Food Engineering, Food Chemistry, Physiology and Biochemistry.
- 2.3 explain and evaluate the nutritional needs of individuals throughout the life cycle.
- 2.4 explain and evaluate the scientific principles involved in food processing.
- 2.5 identify and explain changes that occur in food during processing.
- 2.6 demonstrate and evaluate simple techniques in food processing.
- 2.7 evaluate the national and relevant aspects of international mandatory policies on food quality assurance.
- 2.8 analyse and evaluate the composition of food in relation to its chemical and physical characteristics.
- 2.9 identify and evaluate the environmental, cultural and socio-economic factors affecting food security.
- 2.10 identify microbial and chemical agents that affect food safety and hygiene.
- 2.11 evaluate the manufacturing practices that affect food safety and food security.
- 2.12 follow a sequence of instructions in experimental and other pieces of project work.
- 2.13 use techniques, apparatus and materials.
- 2.14 make and record observations, measurements and estimates.
- 2.15 interpret and evaluate observations and experimental data.

2.16 devise and plan investigations, select appropriate techniques, apparatus and materials.

2.17 evaluate methods and techniques, and suggest possible improvements.

3. Scheme of Assessment

This syllabus provides candidates with the opportunity to develop knowledge in both theoretical and practical aspects of Food Science and Nutrition. Candidates will sit four papers as follows:-

Paper	Paper Type	Duration	Marks	Weighting
1	Multiple Choice	1 hour	40	20%
2	Structured and Free Responses	3 hours	100	40%
3	Practical	2 ½ hours	60	25%
4	Guided Research Project	To be done and completed in the final year	100	15%
Total			300	100%

All four papers are compulsory.

Paper 1 *Multiple Choice*

This paper will consist of **40** questions

Paper 2 *Structured and Free Response*

This will test the candidates' knowledge of theory and practice. Candidates will be required to answer four questions – two from Section A and two from Section B.

Section A consists of **three Nutrition questions** from which candidates must answer **two** questions of their choice.

Section B consists of **three Food Science questions** from which candidates must answer **two** questions of their choice.

Paper 3 *Practical Paper*

This paper is designed to assess the extent to which a candidate displays competence in practical skills. Candidates will be familiar with apparatus appropriate to school science laboratories and techniques in the use of such apparatus and chemicals

Candidates will be expected to carry out experiments from the instructions and notes given in the question papers.

Paper 4 *Guided Research Project*

A written report of an investigation undertaken by the candidates during the final year of the course. The investigation must be a personal study linked to the course as a whole and there must be both theoretical and practical application of the course throughout the piece of work. The report should be labeled with the:-

Candidate's Name

Name of Centre

Centre Number

Subject and Paper Number

Title of the Study

The Research Project should be sent to ZIMSEC by the 31st October of the final year.

SYLLABUS CONTENT

4. Nature and Functions of Nutrients

4.1 Proteins

Classification

- Chemical classification.
- Primary, secondary, tertiary and quaternary structure.
- Simple, conjugated, globular and fibrous proteins.

Basic Structure

- Classification of amino acids.
- Chemical structure.
- Chemical and physical properties
 - effects of heat, acids, alkalis, salts, tannins and agitation.

Protein Quality

- Essential and non-essential amino acids.
- Measurement of protein quality
- Biological value
 - coefficient of digestibility
 - N.P.U
 - Chemical score

Functions

- Structural
- Transport
- Protective
- Regulatory (enzymes and hormones)

RV(RDI,RDA)

- Requirements for different age groups
- Protein related problems
 - phenylketonuria
 - protein energy malnutrition (PEM)

Suggested Experiments

- Test for protein
 - biuret test
 - lowry test
 - optical density
- Test for amino acids
 - ninhydrin test
- Acid hydrolysis for proteins
- Test for pH
 - litmus test
 - phenolphthalein
- Effects of heat treatment and agitation.

4.2 Carbohydrates

Classification

- Simple and compound sugars

Chemical structure

- Monosaccharides
- Disaccharides
- Polysaccharides
- Sugar alcohols

Chemicals properties

- Reducing and non-reducing sugars, sugar alcohols, sugar acids.

Effects of moist and dry heat on sugars and starches

- Caramelisation
- Dexterisation
- Gelatinisation (role of amylase and amylopectin, gel formation and pectic-gels in jam making).
- Maillard reaction (non-enzymatic browning) between sugars and amino acids.

Artificial sweeteners

- General characteristics
- Degree of sweetness
- Carcinogenicity

Functions

- Monosaccharides
- Disaccharides
- Polysaccharides
- Non-starch polysaccharides

RV(RDI,RDA)

- Requirements for different age groups
- Carbohydrate-related problems
 - diabetes and lactose intolerance
 - malabsorption of micronutrients
 - diverticulosis

Suggested experiments

- Test for starch and reducing sugars
- Test for non-reducing sugars and alcohol
- Effects of moist and dry heat on carbohydrates
- Jam making

4.3 Lipids

Classification

- Simple and compound lipids

Chemistry of lipids

- Fatty acids and glycerols
- Triglycerides, waxes, phospholipids and steroids
- Saturated and unsaturated fatty acids (mono and polyunsaturated)
- Omega 3, 6 and 9 fatty acids

Chemical reactions

- Hydrogenation
- Hydrolysis
- Decomposition

Physical reactions

- Melting and smoke points
- Plasticity
- Emulsification

Functions

- Transport
 - HDL and LDL
- Structural
 - cell membranes
- Storage
 - adipose tissue

RV (RDI, RDA)

- Requirements for different age groups
- Importance of cholesterol

Suggested Experiments

- Test for lipids
 - cellulose test on saturated and unsaturated fats
- Melting and smoke points of different fats and oils
- Iodine value
- Peroxide value
- Simple test on emulsification.

4.4 Micronutrients

4.4.1 Vitamins

- Fat soluble A, D, E, K
- Water soluble – thiamine, riboflavin, niacin, ascorbic acid, folate, cobalamin, pyridoxamine
- Food sources and supplementation protocols.

Functions

- Energy production
- Protective
- Structural
- Regulatory
- Anti-oxidant

RV, (RDI, RDA)

- Requirements for different age groups
- Effects of excessive intake
- Results of deficiencies

Suggested Experiments

- Determinations of ascorbic acid in fruit juices and carbonated beverages
- Vitamin C retention test

4.4.2 Minerals Elements

- Calcium, phosphorus, sodium, fluorine, chloride, iron, iodine, zinc, magnesium, potassium
- Food sources and supplementation protocols

Functions

- Energy production
- Protective
- Structural
- Regulatory

RV, (RDI, RDA)

- Requirements for different age groups
- Effects of excessive intake
- Results of deficiencies

4.4.3 Trace Elements

- Cobalt, copper, manganese, selenium
- Food sources and supplementation protocols.

Functions

- Energy production
- Protective
- Regulatory

RV, (RDI, RDA)

- Requirements for different age groups
- Effects of excessive intake
- Results of deficiencies

4.5 Water

- Sources of water
- Chemistry of water
- Solubility
- Water activity
- Ionisation
- Hard and soft water
- Purification – basic processes in domestic and industrial water purification

Functions of water in the body

- Electrolytic
- Transport
- Regulatory/metabolic
- Temperature control

RV, (RDI, RDA)

- Requirements for different age groups

Suggested Experiments

- Movement of water through semi-permeable membranes, to include:-
 - plasmolysis
 - turgidity
- Surface tension

5. Energy

Energy requirements in life cycle

- RV (RDI, RDA)
- Energy balance
- Calculating energy values of foods
- Recommended percentage values of energy nutrients

Measurement of heat energy

- Kilojoules (kJ) or kilocalories (kCal/CAL)
- Energy values of:
 - 1g glucose
 - 1g protein
 - 1g fat

Uses of energy

- Growth
- Physical activity
- Metabolism

Individual energy needs

- Basal metabolic rate (BMR)
- Physical activity levels

Basic nutritional guidelines

- Food pyramids
- Proportions and dietary carbohydrates, proteins and fats in meals

6. Nutrient – nutrient interaction

Nutrient Interaction

- Food choices
- Effects of divalent minerals on absorption of other nutrients

- Effects of fats on absorption of fat – soluble vitamins
- Effects of Vitamin C on iron absorption
- Effects of Vitamin D on calcium absorption

7. Effects of processing on nutrients

Protein, carbohydrates and lipids

- Denaturation
- Hydrolysis
- Dehydration
- Peroxidation
- Oxidation

Micronutrients

- Oxidation, leaching, heat/light effects of, deactivation, pH, tannins

Suggested experiments

- Leaching
- Amounts of Vitamin C before and after processing
- Vitamin retention test, e.g. urine test after taking Vitamin C tablets
- Enzymatic browning in apples, bananas, avocado pears, and egg plants

8. Physiology

Digestion

- Digestion of food
- Absorption of food
- Assimilation of energy nutrients to include passive absorption, active transport (endocytosis)

Metabolism of energy nutrients

- Cell respiration to produce energy,
- Krebs cycle – metabolism of carbohydrates, fats and proteins

- Simple mention of steps involved in glycolysis
- Glycogen formation, lipogenesis
- Amino acid metabolism

9. Food Additives

Functions and uses

- Preservatives
- Colourings
- Flavourings
- Flavour enhancers
- Emulsifiers
- Stabilisers
- Anti-oxidants
- Sweeteners
- Flavour improvers and humectants
- Bulking agents

Suggested Experiments

- Action of preservatives, e.g. antioxidants
- Action of sodium potassium tetrataurate on egg-white

10. Food Labelling and Packing

Labeling

- Requirements/legislation
- Reasons for labeling

Packaging materials and testing

- Glass, plastic, metal, paper

Types of containers

- Pressured, non-pressured, seamless, tetrapack, rigid containers, flexible containers, pre-formed hermetic, incline forming

Suggested Experiments

- Shelf-life tests
- Package testing
- Identification of additives in commonly used products (on market)

11. Nature of Foods and Their Processing

11.1 Cereals and Cereal Products

Structure of cereal grains

- General composition and structure of wheat, rice, maize, sorghum

Processing of cereals

- Process of milling
 - wheat
 - rice
 - maize
 - sorghum/millet

All to include flow charts

Cereal products

- Process of industrial breadmaking, to include flow chart
- Process of making breakfast cereals to include
 - cornflakes
 - branflakes
 - riceflakes

Suggested Experiments

- Action of leavening agents
- Gelatinisation of starch
- Dextrinisation of starch

11.2 Fruit and Vegetables

Structure and general characteristics of fruit and vegetables

- Classification
- Composition
- Physical characteristics
- Factors affecting characteristics, e.g. colour, texture, flavour.

Processing of fruit and vegetables

- Basic steps in processing to include:
 - washing
 - trimming
 - cutting
 - blanching
 - sterilising
 - canning
 - freezing
 - freeze drying
 - drying

All to include flow charts

- Fruit processing by preservation to include:
 - blanching
 - ascorbic acid dip
 - sulphur dioxide dip
 - sugar syrup
 - vacuum treatment
 - pickling

Fruit and vegetable products

- Process of jam-making/jelly-making.
- Fruit juice production, to include flow chart.

11.3 Milk and Milk Products

Nature of milk

- Composition
- Grading of milk
- Quality tests

Processing of milk

- Basic processes involved to include:
 - high temperature/short time.
 - ultra heat treatment (include flow charts)

Processing of milk products

- Basic processes in the making of:
 - Yoghurt/cultured milk
 - Cheeses
 - Powdered milk

All to include flow charts

Suggested Experiments

- Making of yoghurt
- Phosphatase test
- Methylene blue test

11.4 Meat and Poultry

Nature of meat and poultry

- Composition and structure to include pigments and colour changes.

Processing of meat

- Ageing
- Tenderising
- Curing
- Canning

All to include flow charts

Processing of poultry

- Basic processing, to include flow chart

Suggested Experiments

- Colour changes of meat during processing.

11.5 Legumes

Soya bean and soya products

Nature of soyabeans

- Composition and structure

Processing of soyabeans

- Processes involved in the production of span protein and texturised vegetables protein.

Suggested experiments

- Making soya milk and tofu.

11.6 Eggs and egg products

Nature of eggs

- Composition and structure

Processing of eggs

- Basic processing steps

Suggested experiments

- testing eggs for freshness
- whisking of egg whites
- making of lemon curd

11.7 Fish and fish products

Nature of fish

- Composition and structure
- Classification

Processing of fish and fish products

- Basic processes to include:
 - smoking
 - canning
 - drying
 - salting

Suggested Experiments

- Putrefaction

12. Preservation of Food

12.1 Heat Processing

- Heat transfer
- Mass transfer
- Sterilization – reduction in microbial load
- Lethal dosage
- Thermal curves

Suggested Experiments

- Inactivation of enzymes in vegetables.
- Heat destruction of micro-organisms.

12.2 Cold Processing

- Temperature reduction.
- Concept of refrigeration and cold storage.
- Changes during freezing.
- Commercial freezing methods.
- Changes during storage.

Suggested Experiments

- Effects of freezing on characteristics of food.

12.3 Dehydration

- Heat and mass transfer.
- Factors affecting rate of dehydration.

- Changes during dehydration.
- Equipment and methods of drying, to include:
 - solar vacuum driers
 - roller driers
 - air convection driers.

Suggested Experiments

- Comparisons of solar drying, sun drying and oven drying.

12.4 Concentration

- Methods to include:
 - solar concentrating
 - open kettle
 - flash evaporators
 - freeze concentration.

12.5 Fermentation

- Lactic acid production
- Fermented foods

Suggested Experiments

- Test for protein content in fermented foods
- Test for pH

13. Food Security

Factors affecting food security

- Agricultural practices
- Culture
- Socio-economic factors
- Land and land policies
- Availability of labour and mechanization
- Natural disasters e.g. pests, floods, droughts
- Political environment
- State of health
- Rates of employment.

*Factors influencing
food choices*

- Age
- Family size
- Occupation
- Income
- Gender
- Socio-economic status
- Availability and management of resources
- Nutrition knowledge
- Religion
- Culture

*National and International
policies on food and food
legislation*

- Foods and Food Standard Act of Zimbabwe
- Public Health Act
- Food Control Act
- Agriculture Act
- Role of the Consumer Council of Zimbabwe
- Codex Alimentarius

14. Food Safety and Hygiene

Natural decay

- Decomposition and deterioration of food.
- Ripening and autolysis.
- Effects of bacteria, yeasts, moulds and pests.

*Contamination by
micro-organisms*

- Food contamination by food poisoning bacteria to include:-
 - salmonella,
 - staphylococcus aureus,
 - clostridium,
 - perfringes,
 - clostridium botulinium,
 - bacillus.

- Prevention of cross contamination by bacteria.
- Food and personal hygiene.

*Contamination by
chemicals*

- Chemical contamination – pesticides, herbicides.

SPECIFICATION GRID

Assessment Objective	Paper 1 and Paper 2 Theory	Paper 3 Practical	Paper 4 Research Project
2.1	x		
2.2	x	x	
2.3	x	x	
2.4	x	x	
2.5	x	x	x
2.6	x	x	
2.7	x		x
2.8	x		
2.9	x	x	
2.10	x		x
2.11	x	x	
2.12		x	x
2.13		x	x
2.14		x	x
2.15	x	x	x
2.16			x
2.17	x	x	x
Weighting	60%	25%	15%

Objectives/Components	Paper 1 and Paper 2	Paper 3	Paper 4	Average
Knowledge with understanding	20	20	20	20
Scientific concepts and their application	30	50	30	36
Analysis, synthesis, evaluation, decision making and judgements	50	30	50	44
Totals	100%	100%	100%	100%

RESOURCES

The suggestions made are not exclusive. There are many texts available which would form the basis of a classroom reference library.

1. Lebuza, Theodore, P and Edermen, J.W. Jr (1984). FOOD SCIENCE AND NUTRITIONAL HEALTH: AN INTRODUCTION. St Paul (MN): W Publishing Company.
2. West, CE. Pepping, F and Temalilwa, C.R. (1988). THE COMPOSITION OF FOODS COMMONLY EATEN IN EAST AFRICA. Wageningen: Wageningen Agricultural University on behalf of CTA and ESCA.
3. Potter, Norman, N (1986). FOOD SCIENCE West Port, Connecticut The AVI Publishing Company Inc.
4. Fox. BA and Cameron AG (6th Edition). FOOD SCIENCE NUTRION AND HEALTH. Edward Arnold.
5. Proudlove, R.K. THE SCIENCE AND TECHNOLOGY OF FOODS Forbes.
6. Clydesdul, F. FOOD, NUTRITION AND HEALTH AND HEALTH: AVI Publishing Company Inc. Westport, Connecticut.
7. Desrosicr, N.W. ELEMENTS OF FOOD TECHNOLOGY AVI Publishing Company.
8. Fox, B.A. and Cameron, A.G. (1977) FOOD SCIENCE: A Chemical Approach. University of London Press.
9. Hawthorn J (1981) FOUNDATION OF FOOD SCIENCE Freeman.
10. Hobbs, B (1978) FOOD POISONING AND FOOD HYGIENE Edward Arnord.

The information contained in this document may be subject to alteration in the light of changing circumstances.

Any alterations to previously published information will be communicated to registered Centres.

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