

Subject: Biochemistry (BIOC)				
General				
	Course Units	Status	Pre-requisite	Co-requisite
Year 1 Sem 1	BIOL 11032 Basic Biochemistry (Lecture cum Laboratory) (for BS stream)	C	A/L Chemistry and Biology	
Year 1 Sem 2	BIOC 12113 Introductory Biochemistry (Lecture cum Laboratory) (for PS stream)	C	A/L Chemistry	
	BIOC 12122 Tools in Biochemistry	C/O	BIOL 11032/ BIOC 11113	
	BIOC 12133 Functional Biochemistry	C/O	BIOL 11032 / BIOC 11113	BIOC 12141
	BIOC 12141 Functional Biochemistry Laboratory	C/O		BIOC 12133
Year 2 Sem 1	BIOC 21114 Molecular Biology & Analytical Biochemistry	C/O	BIOC 12133	BIOC 21121
	BIOC 21121 Molecular Biochemistry Laboratory	C/O		BIOC 21114
Year 2 Sem 2	BIOC 22132 Biotechnology	C/O	BIOC 21114	
	BIOC 22142 Introduction to Environmental and Agricultural Biochemistry	C/O	BIOC 12133	BIOC 22151
	BIOC 22151 Environmental and Agricultural Biochemistry Laboratory	C/O		BIOC 22142
Year 3 Sem 1	BIOC 31111 Seminar	C	BIOC 22132	
	BIOC 31122 Immunochemistry & Neurochemistry	O	BIOC 22132	
	BIOC 31132 Pharmaceutical Chemistry	O	BIOC 31122	BIOC 31141
	BIOC 31141 Pharmaceutical Chemistry Laboratory	O		BIOC 31132
	PRPL 31012 Professional Placement	O	All BIOC compulsory units offered in Levels 1& 2	
Year 3 Sem 2	BIOC 32163 Food and Nutritional Biochemistry	O	BIOC 12133 / CHEM 22152	BIOC 32171
	BIOC 32171 Food and Nutritional Biochemistry Laboratory	O		BIOC 32163

BIOCHEMISTRY

LEVEL-1

First Semester (15 weeks)

Course code : BIOL 11032
Course title : Basic Biochemistry (lecture cum laboratory)
Pre-requisites : G.C.E. (A/L) Chemistry and Biology

Learning outcomes:

On successful completion of this course unit, students should be able to,

- recognize the structures and properties of the four major classes of biomolecules and catalytic properties of enzymes
- explain major metabolic pathways
- describe the nature of genetic materials and their molecular processes
- apply basic Biochemistry laboratory procedures used in bio-molecule analysis

Course contents:

Chemical properties of amino acids, formation of peptides, folding of peptide chains to spatial structures, structure and function of carbohydrates, chemical properties of nucleic acids and lipids, nucleotides and coenzymes, enzymes nomenclature and kinetics, general outline of metabolic pathways for carbohydrates, amino acids, nucleic acids and lipids

Practical sessions:

Qualitative and quantitative analysis of amino acids, proteins, carbohydrates, lipids and physical properties of nucleic acids

Method of teaching and learning: A combination of lectures, tutorial discussions and laboratory experiments

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Stryer, L. (2001), *Biochemistry*, Freeman.
2. Voet, D and Voet, G. (1995), *Biochemistry*, John Wiley.
3. Lehninger, L., Nelson, D.L. and Cox, M.M. (2000), *Principles of Biochemistry*, Worth.

Course code : BIOC 12113
Course title : Introductory Biochemistry (lecture cum laboratory)
Pre-requisites : G.C.E. (A/L) Chemistry

Learning outcomes:

On successful completion of this course unit, students should be able to,

- demonstrate a knowledge of Biochemistry at a level that will allow them to follow other courses in biochemistry or related fields
- articulate an understanding of the relationships between chemistry and the biological sciences.
- explain the nature, unique properties of four major classes of building blocks and their biological importance.
- explain the properties of enzymes and basic metabolic processes of biomolecules
- apply basic Biochemistry laboratory procedures used in biomolecule analysis

Course contents:

Biochemical basis of life, structure and function of amino acids, protein, carbohydrates, lipids and membranes, structure and function of nucleic acids, enzymes; catalysis, kinetics and regulation, bioenergetics, metabolism of

biomolecules; glycolysis, citric acid cycle and oxidative phosphorylation, amino acid metabolism and urea cycle, metabolism of nucleic acid and lipids.

Practical sessions:

Analysis of carbohydrates, amino acids, proteins, lipids and physical properties of nucleic acids

Method of teaching and learning: A combination of lectures, tutorial discussions and laboratory experiments

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Stryer, L. (2001), *Biochemistry*, Freeman.
 2. Voet, D and Voet, G. (1995), *Biochemistry*, John Wiley.
 3. Lehninger, L., Nelson, D.L. and Cox, M.M. (2000), *Principles of Biochemistry*, Worth.
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Course code : BIOC 12122
Course title : Tools in Biochemistry
Pre-requisites : BIOL 11032 / BIOC 11113

Learning outcomes:

On successful completion of this course unit, students should be able to,

- demonstrate the ability to use various techniques to study biomolecules,
- demonstrate basic competency in handling biochemical data and interpret them based on biochemical principles

Course contents:

Safety in handling biochemical samples, risk assessment, method validation, Interpretation of data, extract information from experiments reported in literature, experimental design, data reporting, basic tools used in the study of biomolecules, over view of these tools in studying proteins, lipids, carbohydrates and nucleic acids.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course examination

Recommended reading:

1. Reese C. D. (2003), *Occupational Health and Safety Management*, A practical approach. CRC Press.
 2. Rohyt J. F. White B.J. (1990), *Biochemical techniques, theory and practice*, Waveland press.
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Course code : BIOC 12133
Course title : Functional Biochemistry
Pre-requisites : BIOL 11032 / BIOC 11113
Co-requisites : BIOC 12141

Learning outcomes :

Upon successful completion of this course students should be able to,

- explain DNA replication, transcription and translation as molecular processes of accurate transmission and expression of genetic message
- recognize the importance of organizational levels of proteins to its function
- explain the role of pH, temperature, electrolyte concentration on the function of proteins
- explain the methods of enzyme regulation
- describe the biochemical basis of inherited metabolic disorders

Course contents:

Replication and transcription in prokaryotic and eukaryotic systems, operon principle, protein synthesis, post translational modifications, protein purification and synthesis of macromolecules. Proteins; structural evolution and biological activity, plasma proteins and blood clotting, biological membrane and membrane transport, enzyme regulation and mechanism, metabolic disorders and their biochemical assessment.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Stryer, L. (2001), *Biochemistry*, Freeman.
2. Voet, D. and Voet, L. G. (1995), *Biochemistry*, John Wiley.
3. Vanholde, M. (1990), *Biochemistry*, Benjamin.
4. Lehninger, L., Nelson, D. L. and Cox, M. M. (2000), *Principles of Biochemistry*, Worth.
5. Lewin, B. (1997), *Genes IV*, Oxford.

Course code : BIOC 12141
Course title : Functional Biochemistry Laboratory
Co-requisites : BIOC 12133

Learning outcomes :

Upon successful completion of this course unit, students should be able to,

- demonstrate techniques in isolation and purification of proteins and enzymes
- explain the rates of enzymatic reactions and calculate kinetic parameters
- demonstrate the factors affecting glycolysis and transamination

Course contents:

Protein purification techniques, properties of enzymes, enzyme kinetics, calculation of K_m and V_{max} , enzyme inhibition, methods to study transamination, oxidative phosphorylation, role of enzymes in metabolic reactions.

Method of teaching and learning: 3 hour laboratory class per week

Assessment : Continuous assessment and end of course unit examination

Recommended reading :

1. Plummer, D. T. (1987), *An Introduction to Practical Biochemistry*, McGraw Hill.
2. Minch, M. M. J. (1989), *Experiments in Biochemistry*, Prentice Hall

LEVEL-2

First Semester (15 weeks)

Course code : BIOC 21114
Course title : Molecular Biology and Analytical Biochemistry
Pr-requisites : BIOC 12133
Co-requisites : BIOC 21121

Learning outcomes :

Upon successful completion of this course unit, students should be able to,

- explain key stages of cell to cell communication, cell cycle and carcinogenesis.
- describe the organization of the eukaryotic chromosome, the gene and other genetic elements
- recognize basic gene manipulation techniques and apply techniques in cloning genes and genome analysis
- apply the principles of different techniques for separation and analysis of biomolecules

Course contents:

Molecular biology and cell biology (30 h)

Cell signaling, cell differentiation and memory, cell cycle, oncogenes and cancer, Molecular constituents of the cell, chromosome structure, genes and genomes, cytoplasmic genetic elements. Molecular cloning; restriction and DNA modifying enzymes, restriction mapping, cloning vectors, recombinants, DNA transfer into hosts, gene libraries and screening, DNA sequencing,.

Analytical biochemistry (30 h)

Electrophoretic and blotting techniques; agarose gel electrophoresis, southern/northern hybridizations, PCR and applications, uses of GLC, HPLC, FPLC in the analysis of biomolecules, centrifugation/ultracentrifugation techniques, radioisotope techniques, autoradiography. GC-MS / LC-MS in determination of biomolecules, biochemical techniques in disease diagnosis and management.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Freifelder, D (1983), *Molecular Biology*, John Wiley and sons
2. Alberts et al, (1994), *Molecular biology of the cell*, Garland.
3. Brown, T. A. (1990), *Gene cloning, An introduction*, Chapman.
4. Old, R. W. and Primrose, S. B. (1989), *Principles of Gene manipulation, an introduction to genetic engineering*, Blackwell.
5. Williams B.L. & Wilson K. (2003), *Principles and techniques of practical Biochemistry*, Edward Arnold.
6. Gowenlock, A.H. (1988), *Varley's Practical Clinical chemistry*, Heinmann.

Course code : BIOC 21121
Course title : Molecular Biochemistry Laboratory
Co-requisites : BIOC 21114

Learning outcomes :

Upon successful completion of this course unit, students should be able to,

- demonstrate skills required to practice the basic techniques in gene manipulation competently and safely
- apply techniques and methodologies in molecular biology

Course contents:

Sterilization techniques, preparation of plasmid DNA, restriction enzyme digestions, agarose gel electrophoresis and restriction mapping, ligation reactions, plasmid transformation, recombinant selection, Southern/northern transfer techniques and nucleic acid hybridization, over expression of recombinant proteins, PCR, bioinformatics, Western blotting and chromatographic techniques in analysis of biomolecules.

Method of teaching and learning: A 3 hour laboratory class per week (15 weeks)
Pre labs and assignments

Assessment : Continuous assessment and end of course unit examination

Recommended reading:

1. Wilson, K. and Walker, J. (1997), *Practical Biochemistry*, Cambridge.
 2. Renee, R. A. and Griffiths, J. M. (1993), *Basic biochemical methods*, Wiley.
 3. Plummer, D. T. (1987), *An Introduction to Practical Biochemistry*, McGraw Hill.
 4. Zyskind, J. W. and Bernstein, S. I. (1992), *Recombinant DNA Laboratory manual*, Academic.
 5. Sambrook, J., Fritsch, E. F. and Maniatis, T. (1989), *Molecular cloning, A laboratory manual*, Cold Spring Harbor.
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Course code : BIOC 22132
Course title : Biotechnology
Pre-requisites : BIOC 21114

Learning outcomes: Upon successful completion of this course unit, students should be able to,

- apply the concepts of modern cell and molecular biology to manipulate organisms and their products for human benefit
- explain use of enzymes in industry
- explain safety legislations concerning substances hazardous to health and the regulatory requirements of GMOs

Course contents:

Scope and importance, genetic engineering for human welfare, molecular tools in disease diagnosis, gene therapy, transgenic technology for and livestock and crop improvement, molecular markers, mapping useful traits, DNA typing, metabolic engineering, fermentation, bioreactors, single cell protein and biomass production, enzyme technology, industrial uses of enzymes, protein engineering, biosensors and biochips, renewable sources of energy, biomass energy, biogas and biodiesel, biotechnology and biosafety, intellectual property rights and protection, bioinformatics.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Smith J. E. (1997), *Biotechnology*, Cambridge university press.
2. Primrose S. B. (1987), *Modern Biotechnology*, Blackwell publishing
3. Kumar H. D. (2000), *Modern Concepts of Biotechnology*, Vikas publishing
4. Kahn I.M, (2005), *Elementary bioinformatics*, Pharma Book Syndicate,
5. Mount D.W, and Mount D (2002), *Bioinformatics: Sequence and genome analysis*, Cold spring harbor laboratory.

Course code : BIOC 22142
Course title : Introduction to Environmental and Agricultural Biochemistry
Pre-requisites : BIOC 12133
Co-requisites : BIOC 22151

Learning outcomes: Upon successful completion of this course unit, students should be able to,

- explain the biochemical and genetic mechanisms of exchanging signals between plant and soil microorganisms
- demonstrate biofertilizers, biopesticides as valuable tools to achieve future food security through sustainable agriculture
- demonstrate skills required to practice eco-friendly techniques in controlling pollution and waste management.

Course contents:

Biochemistry of soil and rhizosphere, biochemical and genetic process involved in plant- microbe interactions, biological nitrogen fixation, mechanism and genetics, biofertilizers, biopesticides and biological control, cleaner technology, control of pollution, degradation pathways of industrial and agricultural wastes, bioremediation, use of genetically modified organisms in bioremediation, phytoremediation, composting, waste management, bioleaching and biosorption processes, maintenance of biodiversity and conservation.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assesment: Continuous assessment and/or end of course unit examination

Recommended reading:

1. Lynch, J. M. (1990), *Soil Biotechnology*, Blackwell.
2. Lynch, J. M. (1990), *The rhizosphere*, John Wiley

3. Kumar H. D. (2000), *Modern Concepts of Biotechnology*, Vikas publishing
4. Haug G. and Hoffmann, H. (1985), *Chemistry of plant protection*, Springer.
5. Hassal, K.A. (1990), *The Biochemistry and uses of pesticides*, McMillan.
6. Bunce, N. (1998), *Environmental chemistry*, Wuerz.

Course code : BIOC 22151
Course title : Environmental and Agricultural Biochemistry Laboratory
Prerequisites : BIOC 22142

Learning outcomes:

Upon successful completion of this course unit, students should be able to,

- demonstrate skills required to practice techniques to soil biochemical analysis
- apply the chemical methods to analyze manure, animal feeds, and plant material
- demonstrate methods to develop and evaluate biofertilizers and biopesticides
- demonstrate skills required to practice eco-friendly techniques to control pollution and apply such processes to solve related problems in industry

Course contents:

Chemical analysis of fertilizer and organic manure, biochemical analysis of soil. Qualitative and quantitative analysis of stock feeds and plants material, methods to develop and evaluate biofertilizer and biopesticides, Estimation of pesticide residues in foods /soil, bacterial degradation of various industrial dyes, monitoring bioremediation, bioassays for genotoxicity., development of biofuels

Method of teaching and learning: A 3 hour laboratory class per week (15 weeks)
Pre labs and assignments

Assessment : Continuous assessment and end of course unit examination

Recommended reading:

1. Baruah, T. C. and Barthakur, H. P. (1999), *A Text book of Soil analysis*, Vikas.
2. Chopra S. L., Kanwar J. S. *Analytical Agricultural Chemistry*, (2002), Kalyani publishers.
3. Radojevic, M, and Bashkin, V. N. (1999), *Practical Environmental Analysis*, RSC.

LEVEL-3

First Semester (15 weeks)

Course code : BIOC 31111
Course title : Seminar
Prerequisites : BIOC 22132

Learning outcomes:

Upon successful completion of this course unit, students should be able to,

- demonstrate the ability to search, extract, and present appropriate biochemical information from various resources
- apply communication skills effectively to relate ideas both verbally and in writing to specialized and general audiences

Course contents: Selected topics in current fields of Biochemistry and Molecular biology.

Method of teaching and learning: Self studies, small group discussions, and through feedback on reports and oral presentations.

Assessment: Oral examination and report

Recommended reading:

1. Review papers from current biochemical literature.

Course code : BIOC 31122
Course title : Immunochemistry and Neurochemistry
Prerequisites : BIOC 22132

Learning outcomes :

Upon successful completion of this course unit, students should be able to,

- explain the defense mechanism of human body focusing the body's response to invading microorganisms
- demonstrate the experience of most important immunological detection and assay techniques
- explain how the nervous system helps to sense the changes in the environments and respond to them.
- rationalize the chemical nature of human behavior

Course contents:

Immunochemistry (15 h)

Innate and acquired immunity, antigens, antibodies, antibody and antigen recognition, homogeneous and heterogeneous antibodies, antibody diversity, complement system, T cells and classes of T cells, T cell receptors, MHC proteins and their role in antigen recognition, immunohaematology, detection of antibodies.

Neurochemistry (15 h)

Molecular mechanism of synaptic transmission, receptor subtypes; function and mechanism, excitatory and inhibitory neurotransmitters; structure, function and metabolism, signal transduction pathways, biochemistry of neuropathy in ischemia and hypoxia, molecular targets of abused drugs and their effects on the nervous system.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading :

1. Johnstone, A. P. and Turner, M. W. (1997), *Immunochemistry*, Oxford.
2. Stryer, L. (2001), *Biochemistry*, Freeman.
3. Lehninger, L., Nelson, D. L. and Cox, M. M. (2000), *Principles of Biochemistry*, Worth.
4. Siegel, G. J., Agranoff, B. W., Alber, R. W. and Molinoff, P. B. (1993), *Neurochemistry*, Reven.

Course code : BIOC 31132
Course title : Pharmaceutical chemistry
Prerequisites : BIOC 31122
Corequisites : BIOC 31141

Learning outcomes :

Upon successful completion of this course unit, students should be able to,

- explain processes involved in the drug discovery and optimization
- describe the importance of SAR and QSAR approaches in modern-day rational drug design and development
- describe common drug metabolic pathways and their importance in designing effective drugs
- explain the importance of biotechnology in drug industry

Course contents:

Ligand-receptor model of drug action, drug-receptor theories, structure activity relationship, drug development, lead discovery, lead modification, drug binding, chiral drugs, quantitative structure activity relationship, Hansch equation, drugs targeting DNA and RNA, drugs targeting enzymes, antibacterial agents, cholinergics, anticholinergics, acetylcholinesterases, NSAIDS and opium analgesics, mechanisms of drug resistance, drug

synergism, pharmacogenomics, biotechnology based drugs, drug absorption and distribution, pharmacokinetics, drug metabolism, traditional medicines and aromatherapy

Method of teaching and learning: A combination of lectures and tutorial discussions

Assesment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Sammes, P. G. (1990), *Comprehensive Medicinal Chemistry*, Pergamon.
2. Patrick, G. L. (1998), *An introduction to medicinal chemistry*, Oxford.
3. King F.D. (2001), *Medicinal chemistry principles and practice*, The Royal society of chemistry13.
4. Krogsgaard-larsen P, Liljefors T and madsen U (1996), *A text book of drug Design and Development*, Harwood academic publishers

Course code : BIOC 31141
Course title : Pharmaceutical Chemistry Laboratory
Co-requisites : BIOC 31132

Learning outcomes :

Upon successful completion of this course unit, students should be able to,

- demonstrate skills required to practice standard techniques in identifying, quantifying, and synthesizing pharmaceutical drugs
- apply standard techniques to isolate novel leads and to evaluate their pharmacological activities.
- apply techniques and methodologies in pharmaceutical chemistry to solve related problems.

Course contents:

Methods of qualitative identification of drugs, colour tests, TLC, use of titrimetry, colorimetry, HPLC for quantitative estimation of active drug ingredients, synthesis and purification of drugs, analysis of drug metabolites, methods of isolation of novel drugs from natural sources, such as plants, microbes, etc. bioassays to determine biological activity of botanicals, standard tests for anti microbial drugs, antibiotic sensitivity tests.

Method of teaching and learning: A 3 hour laboratory class per week (15 weeks)
Pre labs and assignments

Assessment : Continuous assessment and end of course unit examination

Recommended reading:

1. Plummer, D. T. (1987), *An Introduction to Practical Biochemistry*, McGraw Hill.
2. Minch, M. M. J. (1989), *Experiments in Biochemistry*, Prentice Hall.
3. Freifelder, D. (1982), *Physical Biochemistry*, Freeman.

Course code : PRPL 31012
Course title : Industrial/Professional training
Prerequisites : BIOC 22132

Learning outcomes:

Upon successful completion of this course unit, students should be able to,

- develop creative thinking, skills needed to work in an industry
- use of initiative, personal organization, adapting to an unfamiliar environment and apply time management.

Course contents:

An industrial training on application of principles of the biochemistry at a biochemistry resources based industry to improve their laboratory and generic skills

Method of teaching and learning: Training under the supervisor and guidance of academic staff and relevant industry for six weeks

Assessment: Evaluation of the progress report submitted by the trainee

Course code : BIOC 32163
Course title : Food and Nutritional Biochemistry
Pre-requisites : BIOC 12133/ CHEM 22152
Co-requisites : BIOC 32171

Learning outcomes:

Upon successful completion of the course unit, the student should be able to,

- explain the structure and chemical composition of main food groups and chemistry of food deterioration
- describe the array of processes in food industry
- assess the biochemical and nutritional quality of food and understand changes during processing
- explain the effect of major and micro nutrients relevant to human health.

Course contents:

Food Chemistry (15 h)

Occurrence, structure, properties and analysis of food carbohydrates, lipids and proteins; Toxins of plant and animal foods; endogenous toxins, mycotoxins and bacterial toxins, Chemical changes occurring during food spoilage; browning, staling and rancidity. Food additives including legislation and standards; preservatives, antioxidants, food colours, flavours, emulsifiers and stabilizers

Food Technology (15 h)

Biochemical and chemical changes involved in processing of dairy foods, non-alcoholic beverages (tea and coffee), fish and meat products, fruits and vegetables, bakery products including cereals, confectionary including chocolates, vegetable oils; Effects of nutritional quality on food during processing; Principles and practices of food packaging

Nutritional biochemistry (15 h)

Quality assessment of foods based on nutritional factors, role of dietary supplements and functional foods, energy balance and weight management, , nutritional requirements in childhood, adolescence, adult and aging, consequences of unbalanced diet, modifications of the diet to overcome metabolic disorders, relationship between nutrition, Physiology and Biochemistry for health and fitness.

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Potter, N. N. and Hotchkiss, J. H. (1997), *Food Science*, Aspen.
 2. Belitz, H. D. and Grosch, W. (1986), *Food Chemistry*, Springer.
 3. Gunn, D. L. and Stevens, J. G. R, (1979), *Pesticides and Human warfare*, Oxford
 4. D W S Wong, (1996) *Mechanism and Theory in Food Chemistry*, Chapman & Hall
 5. Haug, G. and Hoffmann, H. (1985), *Chemistry of Plant Protection*, Springer.
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Course code : BIOC 32171
Course title : Food Chemistry and Nutritional Biochemistry Laboratory
Co-requisites : BIOC 32163

Learning outcomes: Upon successful completion of the course unit, the student should be able to,

- apply AOAC methods in food analysis
- demonstrate skill of detecting nutritional quality of food .
- apply the knowledge of the biochemical changes occur during the food processing.

Course contents:

AOAC methods in food analysis, detection of nutritional quality of raw food and processed food, detection of phenolic, organic acids, antioxidants in food, phytates and oxalates in leafy vegetables, estimation of carotenoids, dietary fiber in food, browning reactions and lipid peroxidation in food,

Method of teaching and learning: A combination of lectures and tutorial discussions

Assessment: Continuous assessment and /or end of course unit examination

Recommended reading:

1. Miller D.D., (1998), Food Chemistry Laboratory manual, John Willey and Sons
 2. Connie W. (1996), The Food Chemistry Laboratory Science, CRC press
 3. Nielsen, S. S. (1998), *Food analysis second edition*, Aspen.
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