

BACHELOR OF SCIENCE (AGRICULTURAL BIOTECHNOLOGY)

1.0 INTRODUCTION

Agriculture is the principal sub-sector in the economies of Kenya and many developing countries in the absence of a strong industrial sector. It is a source of income and employment, affiliated entrepreneurs, and earns foreign exchange. To be competitive, agricultural production is now increasingly being characterised by the use of modern technologies. The further development of agriculture and its related industries is challenging and requires appropriate knowledge and skills to keep pace with the latest technological developments in that sector. Biotechnology is an emerging field, which has influence on almost on every sector of humanity, and has vast technologies for unlocking new potential. The Bachelor Degree in Agricultural Biotechnology is a multi-disciplinary course with good potential to provide in-depth scientific knowledge of biotechnology as well as technical and practical skills used in agricultural biotechnology. The course is in line with the Kenya Government policy and Vision 2030 Strategic Plan for the future and beyond for adoption of a technology-based approach to render the local agricultural sector more productive, service-oriented, sustainable and competitive whilst responding to the environmental and ethical standards demanded by society.

2.0 OBJECTIVES

This degree programme aims to equip students with a broad spectrum of scientific, technical and managerial skills needed to contribute to the future success of agriculture.

The specific objectives are:

- (a) To familiarize students with the techniques used in agricultural biotechnology.
- (b) To equip students with knowledge and skills on the use of transgenic approaches for the generation of useful agricultural products.
- (c) To create awareness on the diversity of socio-economic, ethical and legal issues relating to agricultural biotechnology.

3.0 ADMISSION REQUIREMENTS

- (a) Candidates must satisfy the minimum university requirements of mean grade of C+.
- (b) In addition to above, candidates should have atleast a C+ or above in Biology and chemistry, and C in Physics and Mathematics.

OR

- (c) Holders of KACE with two principal passes in science subjects and at least a credit in Mathematics at Ordinary level.

OR

- (d) Holders of diploma in agricultural or related fields from a recognized college.

OR

- (e) Holders of a related degree from a recognized University.

4.0 COURSE STRUCTURE AND DURATION

- (a) The degree shall normally take four academic years of 8 semesters.
- (b) Courses shall be offered in units. A course unit is defined as that part of a subject described by a coherent syllabus and taught normally over a period of a semester. It is designated as a total of 42 Hours of study in a semester. For this purpose one 1-hour lecture is equivalent to one 2-hour tutorial or 3-hour practical or any combination as may be approved by the Board of the School of Agriculture, Food Security and Biodiversity.
- (c) Part-time students shall be allowed to take not less than 50% of the courses prescribed for the year.
- (d) All courses will be taught for a total of 42 contact Hours, including examinations except industrial attachment which will take 480 Hours of practical work in a relevant industry.
- (e) Students shall be required to undergo an Industrial Attachment of three (3) months at the end of 2nd semester of the third year of study.

5.0 CREDIT TRANSFER

Students may be exempted from some courses by Senate on recommendation of the School Board.

6.0 EXAMINATIONS REGULATIONS

University Examinations rules and regulations shall apply.

7.0 COURSE DISTRIBUTION

YEAR 1 SEMESTER 1					
Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
EEL 3115	Communication Skills*	42	0	42	1R
SCS 3111	Computer Organization and Applications*	28	14	42	1R
SB1 3114	HIV and AIDS*	42	0	42	1R
SMA 3111	Mathematics I*	42	0	42	1R
AAE 3113	Farming Systems and Rural Livelihood*	42	0	42	1R
SCH 3111	Physical Chemistry*	28	14	42	1R
APT 3111	Agricultural Botany*	42	0	42	1C
SCH 3112	Organic Chemistry*	28	14	42	1R
	Total	294	42	336	8
YEAR 1 SEMESTER 2					
Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
AAB 3125	Agricultural Biochemistry	28	14	42	1C
AAB 3121	Agricultural Microbiology	28	14	42	1C
AAS 3123	Animal Physiology*	28	14	42	1C

SCH 3129	Bioinorganic Chemistry	28	14	42	1R
APT 3125	Principles of Crop Production*	28	14	42	1C
SLB 3121	Development Studies*	42	0	42	1R
SMA 3111	Mathematics II*	42	0	42	1R
	Total	266	70	336	8

YEAR 2 SEMESTER 1

Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
AAB 3211	Molecular Cell Biology	28	14	42	1R
AAE 3214	Principles of Agricultural Marketing	28	14	42	1R
APT 3216	Principles of Plant Pathology*	28	14	42	1C
APT 3212	Field Crop Production*	28	14	42	1C
APT 3213	Principles of Organic Farming*	28	14	42	1R
AAB 3214	Dairy Production	28	14	42	1C
APT 3215	Crop Entomology*	28	14	42	1C
APT 3217	Principles of Plant Physiology*	28	14	42	1C
	Total	224	112	336	8

YEAR 2 SEMESTER 2

Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
AAB 3226	Cell/Tissue Culture & Transgenic Technologies	28	14	42	1C
AAB 3221	Biotechnology in Animal	28	14	42	1C

	Production				
AAS 3221	Principles of Animal Production*	28	14	42	1C
AAS 3222	Non-ruminant Husbandry	28	14	42	1C
AAB 3223	Industrial Microbiology and Fermentation Technology	42	0	42	1C
AAB 3224	Techniques in Biochemistry and Molecular Biology	28	14	42	1R
AAB 3225	Molecular Plant Breeding	28	14	42	1C
	Total	252	84	336	8

YEAR 3 SEMESTER 1					
Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
ALS 3311	Research Methodology*	42	0	42	1R
AAB 3311	Genetic Engineering of Crops	28	14	42	1C
APT 3313	Crop Protection*	28	14	42	1C
AAB 3312	Enzyme Biotechnology in Food Processing	28	14	42	1C
AAE 3312	Analysis and Planning of Agricultural Projects	28	14	42	1R
BEN 3315	Entrepreneurship*	42	0	42	1R
AAB 3314	Animal Health	28	14	42	1C
AAB 3313	Animal Breeding	28	14	42	1C
	Total	266	70	336	8

YEAR 3 SEMESTER 2					
Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
AAB 3321	Technological Applications in Food Processing	42	0	42	1C
AAB 3322	Dairy Process Biotechnology	28	14	42	1C
AAB 3326	Animal Genetic Engineering	42	0	42	1C
APT 3323	Greenhouse Technology and Protected Cultivation*	28	14	42	1C
AAB 3324	Post Harvest Biotechnology of Cereals	42	0	42	1C
AAB 3325	Biostatistics	42	0	42	1R
AAS 3321	Ruminant Animal Husbandry	28	14	42	1C
AAB 3227	Bioinformatics	28	14	42	1C
AEE 3321	Agricultural Extension and Technology Transfer*	42	0	42	1C
	Total	270	56	336	8

YEAR 3: SEMESTER 3	
AAB 3331: Industrial Attachment	480 Hours

YEAR 4 SEMESTER 1					
Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
AAB 3411	Veterinary Biotechnology	28	14	42	1C
APT 3413	Horticultural Production*	28	14	42	1C
AAB 3412	Biotechnology in Horticulture	28	14	42	1C
AAB 3413	Biotechnology of Ruminant Feed Utilization	28	14	42	IC
AAB 3416	Biopesticides and Biofertilizers	28	14	42	IC
AAB 3417	Research Project I	0	42	42	IC
AAB 3415	Food and Nutrition Security of GM Food Crops	42	0	42	IC
	Total	182	112	294	7

YEAR 4 SEMESTER 2					
Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
AAB 3421	GMOs, Biosafety & Bioethics	42	0	42	1C
AAB 3422	Current Topics in Agricultural Biotechnology	42	0	42	1C
AAB 3423	Intellectual Property Right (IPR) and Patents	42	0	42	1C
AAB 3417	Research Project II	0	42	42	IC
AAB 3425	Agricultural Management* Project	42	0	42	IR

AAE 3423	International Agricultural Trade*	42	0	42	1C
AAE 3427	Farm Management*	42	0	42	1C
	Total	252	42	294	7

* Already approved units

C: Core course, which is central to the discipline of study.

R: required course, which is supportive or beneficial to the programme.

8.0 COURSE DESCRIPTION

YEAR 1 SEMESTER 1

EEL 3115: Communication Skills

42 Hours

Study Skills; Planning study time, making references, filing notes, preparing for examinations. Library Skills; Organization, classification, shelving, using reference books. Listening Skills; Asking and answering questions in lectures and seminars, making and defending arguments, agreeing and disagreeing, explaining points clearly. Academic reading skills; Skimming and scanning, notes making, understanding footnotes and bibliographical references.

SCS 3111: Computer Organization and Applications

42 Hours

Organization: Introduction to the computer and the notion of a programmable machine. The basic organization based on the von Neumann model. Functional components (CPU, memory, I/O) and their logical organization. Number systems and internal data representation. Concept software and types of software. Components of contemporary personal computer systems from end-user perspective; Application: Classical and contemporary applications of computers. Proficiency in basic computer usage and productivity/office automation applications including word-processing, spreadsheets, e-mail, web, etc. Basic first year security and maintenance issues. Ethical and societal issues.

SBI 3114: HIV and AIDS

42 Hours

Introduction; Historical background and magnitude of HIV and AIDS; General organization of the human body; Reproduction, immune system (human physiology) and other factors; Sex and

sexuality; The biology of the human immunodeficiency virus and viral transmission; Stages of infection and the development of HIV and AIDS; Opportunistic infections; HIV and AIDS prevention and infection control; Peer education for HIV; Treatment options and vaccine development; Blood transfusion and HIV and AIDS; Management of HIV and related infections; Legal and Ethical Issues in HIV AND AIDS; Factors that influence the spread of HIV and AIDS in Africa; Case studies in selected countries in Africa; HIV and AIDS as a national disaster and its impacts; Myths and emerging issues on HIV and AIDS.

SMA 3111: Mathematics I

42 Hours

Elementary set theory. Mappings and functions: Definitions, domains, codomains, range and inverses and composition of functions. Trigonometry: Functions, their graphs, inverses, degree and radian measure, sine and cosine formulae, trigonometric identities and equations. Algebra: Quadratic equations. Surds, logarithms and indices. Series: Arithmetic and geometric progressions, Permutation and combinations. Binomial theorem and applications such as approximations, simple and compound interest. Remainder theorem applications to solutions of factorials polynomials. Statistics: Collection and representation of data. Measures of central tendencies and variability. Graphical and axiomatic approaches to probabilities. Tree diagrams. Probability: Definition, axioms, tree diagram.

SCH 3112: Organic Chemistry

42 Hours

Introduction to amino acids: Proteins- primary, secondary, tertiary and quaternary structures. Protein denaturation, introduction to lipids, neutral lipids, polar lipids. Fatty acids: structure, properties and nomenclature. Steroids and terpenes. Chemistry of bacterial and plant cell walls.

SCH 3111: Physical Chemistry

42 Hours

The structure and properties of matter, origin of elements, evolution of living organisms from chemical systems, bond formation and molecules. Laws of thermodynamics, Steady state kinetics, Reaction kinetics, various functional groups of organic molecules and their biological roles. Carbohydrates; Structure and properties of mono-, di- and polysaccharides.

APT 3111: Agricultural Botany

42 Hours

Plant cells, tissues, organs; Morphology and anatomy of angiosperms root, stem, leaf, flower, fruit, seed and seedling; Primary and secondary growth of plants; Persistent and successive

cambia; Morphogenesis and differentiation; Plasticity of plant organs; Relationship between plant structure, function, and ecological adaptation; Evolutionary trends in anatomy and morphology of crop plants; Totipotency, sectioning and staining; Preparation of main botanical agents; The concept of artificial and natural plant classification; Role of fossil angiosperm and gymnosperms in taxonomy; Taxonomic hierarchy; Specific variation and isolation; Nomenclature; Herbarium and its relevance/role in plant taxonomy.

AAE 3113: Farming Systems and Rural Livelihood

42 Hours

Processes of environmental, economic and social change from the global, regional and local perspectives; Emergence of new forms of production, exchange, consumption, and governance; Impacts of global and regional production and consumption trends and changes on food and agriculture; Structure and dynamics of agri-food systems; Trade liberalization; Deregulation of foreign investment; Government divesture in the agricultural sector; Privatization and globalization of agricultural commodity chains; Ascendance of regional and global retailers in poor economies; Governance restrictions and operation of agri-business supplies; Agricultural commodity value chains; Consolidation of food processing and manufacturing; Farming system determinants; Pro-poor farming systems approaches and methodologies.

YEAR 1 SEMESTER 2

AAB 3215: Agricultural Molecular Biochemistry

42 Hours

Biochemistry - Definition, scope and importance in Agricultural Biotechnology, Concept of life and living processes; Structure and functions of cells and organelles; Biomolecules: Polysaccharides, sugars; storage polysaccharides; Lipids, classification and properties, biological membranes; Proteins, amino acids, covalent and 3-D structure of proteins; Enzymes, properties and mechanism of actions, enzyme kinetics; Metabolic pathways, thermodynamics, Energy metabolism: pathways respiration and ATP synthesis; Photosynthesis; Nucleic acids and protein synthesis; Classification, chemical structure and properties of food constituents and food additives; Primary sensory attributes of food and perception of food quality.

SCH 3129: Bioinorganic Chemistry

42 Hours

Perspectives of occurrence, of metals in Biological systems; Concepts of metal essentiality and toxicity, abundance and availability, sequestering and storing of essential elements; Antagonism among essential elements, ion pumps; Sodium/potassium pumps; Metalloporphyrins and related systems - Oxygen carriers haemoglobin and myoglobin, dioxygen activating copper proteins;

Ferredoxins, cytochromes Iron carriers - transferrins and ferritins; Nitrogen fixation nitrogenase - nitrogen fixation through metal complexes; Photosynthesis - chlorophyll, its structure and function; Role of Manganese in photosynthesis.

AAB 3121: Agricultural Microbiology

42 Hours

History of Microbiology: Spontaneous generation theory; Role of microbes in fermentation; Germ theory of disease; Protection against infections; Applied areas of Microbiology; Metabolism in bacteria; Bacteriophages, structure and properties of Bacterial viruses – Lytic and Lysogenic cycles: viroids, prions; Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation; Microflora of Rhizosphere and Phyllosphere; Microbes in composting; Microbiology of food, microbial spoilage and principles of food preservation; Beneficial microorganisms in Agriculture - Biofertilizer (Bacterial, Cyanobacterial and Fungal), Microbial Insecticides, Microbial agents for control of Plant diseases; Biodegradation, Biogas production, Biodegradable plastics; Plant-Microbe interactions.

AAS 3123: Animal Physiology

42 Hours

Importance and classification of livestock and birds of economic importance; Important breeds of Cattle, Sheep, Goats and their physical and economic characteristics; Study of the basic physiology of the organ systems in farm animals; Neuro-endocrine control of physiological processes in the body; Anatomy of reproductive system of male and female bovine and ovian; Role of hormones in male and female reproductive mechanism, gametogenesis, oogenesis, oestrous cycle, ovulation, fertilization, implantation and pregnancy diagnosis; Fertility and infertility and sterility; Systems of breeding: inbreeding, outbreeding Anatomy and structure of mammary gland, hormonal regulation of reproduction and lactation; Biosynthesis of milk and its constituents, factors affecting milk yield and composition of milk.

ESD 3121: Social Ethics and Integrity

42 Hours

Definitions and concepts; Categories of ethics; national cohesion; integrity; Unity; Structural injustices; ethnicity: Positive ethnicity, negative ethnicity; Peace: Peace making, peace building, peace transformation; Stake holders in national cohesion.

APT 3125: Principles of Crop Production

42 Hours

Concept of crop production, energy/biomes transfer systems; Environmental factors determining crop performance; Cultural practices: seedbed preparation, cultivation, plant seed and seed rates,

plant population; Crop protection; Maintenance of soil fertility: organic and inorganic fertilizers; soil and water conservation; Cropping systems including crop rotation; Intercropping and agro-forestry.

SLB 3121: Development Studies

42 Hours

Development Studies as an autonomous discipline; The concept of development; An overview of the theories and paradigms of development; The relationship between economic growth and development; Science and technology in development; Developed and developing countries; Issues in development: Social, economic and political; Actors in development: The state, national and international NGOs, bilateral and multilateral institutions, multinational corporations (MNCs), and social movements.

SMA 3122: Mathematics II

42 Hours

Coordinate geometry and equations of straight lines. Matrices: definitions, matrix algebra, determinants, transpose, adjoints, inverses and solutions of systems of linear equations using matrix method. Limit continuity. Differentiation and integration of algebraic, trigonometric, exponential functions. Applications of differentiation and integration to rates of change, maxima, minima. Area under curve. 1st order D.E and their application.

YEAR 2 SEMESTER 1

AAB 3211: Molecular Cell Biology

42 Hours

Cellular organizations; Cell metabolism and energetics; Cell surface & cytoplasmic organelles; Phenotype, genes and alleles; Chromosomes and the cell cycle; Properties of DNA; Recombination. Genetic engineering; The basic concept of DNA cloning; DNA cloning vectors; DNA repair; Mutation and mutagenesis; DNA sequencing; Techniques for isolation and characterization of proteins; column chromatography; electrophoresis; blots; Cells and tissues of the immune system; immunological reactions to infections; genetic basis of antibody production; vaccines and immunity; Immunochemical techniques.

AAE 3214: Principles of Agricultural Marketing

42 Hours

Definition of Agricultural Marketing; Marketing functions: Assembly, grading/sorting, transportation, risk bearing and financing; Marketing systems/channels; Structure, conduct and performance of agricultural markets; Supply/value chain analysis; Nature of rural agricultural markets: Information asymmetry and infrastructure; Globalization and marketing of high value commodities; Crop and livestock products; Collective action in agricultural marketing; Agricultural marketing boards/parastatals: Role, effectiveness and efficiency; Risk management in agricultural marketing; Futures markets; Role of agricultural marketing in economic development.

APT 3216: Principles of Plant Pathology

42 Hours

Economic importance of Plant pathology; Concepts and definitions of, nature, cause and control of plant diseases; Agents of infectious and non-infectious diseases; Inoculums and Inoculums potential; Vectors and causative agents of infectious diseases with special reference to fungi, bacteria and viruses; Non-infectious diseases; Stages in disease development, inoculation, infectious, pathogenesis and symptoms; Disease severity and assessment; Epidemiology; Effects of environmental factors on plant diseases; Toxins and plant disease; Disease resistance in plants; Genetics of host plant interactions; Chemical control of plant diseases.

APT 3212: Field Crop Production

42 Hours

Meaning and scope of Agronomy, Field crops-classification with examples. Tillage- Definition, types of tillage, importance and implements used for tillage, manures and fertilizer application and their types, Irrigation-water managements, methods of irrigation, micro irrigation, Weeds: classification of weeds, methods of weed control, cropping systems, organic farming. Agronomy

of important field crops of the region-cereals, indigenous “Orphaned” field crops (traditional vegetables, fruits and cereals), oilseeds, commercial crops, soil and climatic requirements, Land preparation, varieties, seeds and sowing, cultural practices, manuring, irrigation, weed management practices, plant protection measures, harvesting and yield, seed production of important crops.

APT 3213: Principles of Organic Farming

42 Hours

Introduction to trends in tropical agriculture, definition of organic farming and its comparative analysis with respect to profitability, productivity and environmental sustainability; Organic farming techniques; multiple cropping and agroforestry; minimum tillage and enhanced nutrient use efficiency; biological symbionts, green manuring, mulching, composting, integrated plant protection, integration of livestock, certification.

AAB 3214: Dairy Production

42 Hours

Dairy industry in Kenya and the world; Systems of dairy production; Breeds and types of dairy cattle; Feeding and reproductive management; Aspects of calf rearing and clean milk production; Milk marketing.

APT 3215: Crop Entomology

42 Hours

Introduction to the phylum Arthropoda; Taxonomy morphology, anatomy and physiology of the class insecta; Identification, biology and ecology of insects, mites and small vertebrate pests of field crops and stored products and their control; Insect vector of plant diseases; Pollinators and other beneficial insects; Introduction to pesticides (insecticides, acaricides and rodenticides), classification, toxicity and safe use.

APT 3217: Principles of Plant Physiology

42 Hours

Definition, scope and introduction in agriculture, Osmosis, DPD, TP; Water absorption by plants; Ascent of sap; Transpiration-Mechanism, factors affecting it, Structure and function of stomata; Osmotic pressure, guttation; Plant Nutrition: Major and minor nutrients, their roles and deficiency symptom; Active and passive mineral uptake mechanisms; Photosynthesis-Structure and function of chloroplast; Light and dark reactions; Cyclic and non-cyclic electron transfer; C3, C4, Crassulacean

acid metabolism and photorespiration; Respiration types, R.Q; Hormones: types and role in agriculture biotechnology; Growth phases, photoperiodism, and vernalization; Stress physiology (Drought, heat, frost and salinity), mechanism of resistance to above types; Physiological aspects and problems of cereals, oilseeds, cotton and sugarcane.

YEAR 2 SEMESTER 2

AAS 3221: Principles of Animal Production 42 Hours

Animal industries in Kenya; Animal production and its contribution to the economy; Animal production systems as affected by ecological factors; Ecological definitions and concepts in relation to animal production systems and their management; Structure, function and ecology of animal production systems; Basic principles of the management of agricultural ecosystems; The Kenya environment; Major characteristics of the ecological zones of Kenya and effects on animal production; Animal environment and livestock structures; Aspects of livestock structure design; Economics of controlled environment; Animal growth and development of various organs; Tissues and fibers; Variation of growth and development of the body.

AAB 3226 Cell /Tissue Culture and Transgenic Technologies 42 Hours

History, types of tissue culture, advantages and limitations; Culture environment, adhesion, proliferation, differentiation; Development of media- physicochemical properties, complete media, serum and supplements; Principles of plant micropropagation, scope and importance in crop improvement; The totipotency and morphogenesis, organogenesis, rhizogenesis, embryogenesis concept; Micropropagation pathways, Agrobacterium biology, Ti plasmid-based transformation; Callus induction & culture; Meristem culture; Cryopreservation and germplasm storage; Artificial seed Technology; Embryo rescue; Protoplast culture & Somatic hybridization; Animal cell culture techniques and applications; Primary culture – mouse, embryo, chick culture; Cloning and selection; Cyto-toxicity; Specialized cells; Molecular techniques in cell culture.

AAB 3221: Biotechnology in Animal Production 42 Hours

Animal nutrition biotechnology in ruminants and non-ruminants; Biotechnology involving the use enzymes, growth promotants, probiotics, genetic manipulation of rumen microbes; Genetically modified foods in animal nutrition; Consumer and public concern on biotechnology and biotechnology products such as genetically modified organisms (GMOs). Introduction to Animal breeding biotechnology; Quantitative Trait Loci (QTL) and Marker Assisted Selection

(MAS); Gene Mapping and Genetic Distances; DNA finger printing; Polymorphism; Blood groups; Contribution of current biotechnology techniques of genetic improvement and Animals; Basic Computer Simulation.

AAB 3222: Non-Ruminant Husbandry 42 Hours

Non-ruminant agriculture and production systems; Breeds of pigs, poultry, rabbits and races of bees; Application of the principles of breeding and selection, nutrition, housing and health in the management of pigs, poultry, rabbits and bees; Non-ruminant products: handling, processing and marketing.

AAB 3223: Industrial Microbiology and Fermentation Technology 42 Hours

Screening of microorganisms for new products; Improvements of strain, mutant selection; Fermentation process development, shake flask, scale up of process and bioreactors; Metabolite production - antibiotics enzymes, biopesticides, growth regulators, steroids organic acids, bio ethanol and enzymes; Genetically engineered microbes (GEMs); Metabolic engineering; Process and types of bioreactors; Production of yeast and antibiotics, ethanol, lactic acids; Various methods of fermentation.

AAB 3224: Techniques in Biochemistry And Molecular Biology 42 Hours

General principles of biochemical investigations; Units in biochemistry and molecular biology; Principle methods of separation of biomolecules; Centrifugation techniques – basic principles, analytical and preparative centrifugation, their applications; Spectrophotometry: UV-visible spectrophotometer, fluorimetry; Chromatographic techniques – basic principles, types adsorption, partition, ion exchange, molecular sieve, affinity, GLC and HPLC and mass spectrometry; flow cytometry and its application in DNA estimation; Electrophoresis : theory and different types – PAGE, SDS-PAGE, capillary electrophoresis, and IEF; Radioisotope techniques: Nature, detection and measurement of radioactivity, radioactive/non radioactive labeling; Molecular biology techniques – Southern hybridization, northern hybridization, western blotting, microarray technology, complementation techniques, Polymerase chain reaction (PCR), RFLP, AFLP, RAPD; RT-PCR and DNA sequencing.

AAB 3225: Molecular Plant Breeding 42 Hours

Plant Genome – Nuclear and cytoplasmic; Significance of organelle genomes; Genome size and

sequence components; Modern gene concept - Gene structure, structural and functional genes; Molecular markers –Restriction based and PCR based; DNA profiling using different assays-RFLP, RAPD, AFLP, ISSR, SNP etc. Development of SCAR and SSR markers; Gene flow in plants – development of mapping population; Marker Assisted Selection (MAS), screening and validation; Trait related markers and characterization of genes involved; Mapping genes on specific chromosomes; QTL mapping; Gene pyramiding; Transcript mapping techniques. Development of ESTs; Molecular markers for plant genotyping and germplasm analysis; Fidelity analysis; settling IPR issues; Marker Assisted Breeding in transgenics – herbicide resistance, pest and disease resistance, quality enhancement etc. Recent advances – Non-gel based techniques for plant genotyping, homogenous assays, qualitative/Real Time assays; DNA Chip and its technology.

YEAR 3 SEMESTER 1

ALS 3311: Research Methodology

42 Hours

Introduction to research; Meaning and purpose, basic terms; Deductive and inductive approaches. Planning research project; Identifying problem, objectives, hypothesis, literature review, research instruments, budgeting and planning. Logistical and ethical issues in research. Data collection and data analysis; Sampling, classification of variables, preanalysis of data, coding and entering. Research and project development; Writing research proposal, writing project proposal. Writing a research report; Components of research report.

APT 3313: Crop Protection

42 Hours

Introduction to crop protection; Production and post harvest losses; Major crop pests: Flies, mites, nematodes, larvae, insects; Diseases of major crops: bacterial, fungal, viral; Epidemiology of insect pests and diseases; Vectors of major crop pests and diseases; Principles and methods of disease and pest control in crops: Chemical, biological, cultural; Identification and control of weeds; Chemical weed control: Herbicide selectivity and control toxicology and safe use; Pest and disease control in export crops: Integrated pest management and maximum pesticide residue limits; New methods of pest control: Genetic engineering; Trans boundary disease and pest transmission; Role of KEPHIS; Legislation; Information; International conventions. Phytosanitary regulations: Guidelines for pest risk analysis; Guidelines for surveillance; Plant quarantine as related to export trade; Export certification process in Kenya.

AAE 3312: Analysis and Planning of Agricultural Projects 42 Hours

Principles of project analysis and investment decisions; Project cycle management; Project planning under risk and uncertainty; Practical considerations in project planning and investment in Kenya; Capital investment and replacement decisions; Financial planning; Labor and manpower planning; Time as a resource in project planning; Case studies; Application of project planning techniques: Log frame, Gantt chart and program evaluation and review techniques, project appraisal (measuring project costs and benefits); Monitoring, evaluation and impact assessment.

AAB 3311: Genetic Engineering of Crops

42 Hours

Commercial status of transgenic plants; Herbicide resistance, glyphosate, sulfonyl urea, phosphinothricin, atrazine; Pest resistance, Bt toxin, synthetic Bt toxin; Protease inhibitor; GNA and other lectins; α -amylase inhibitor; nematode resistance; Genetic engineering for male sterility-Barnase-Barstar; Delay of fruit ripening; polygalacturanase, ACC synthase, ACC oxidase; Improved seed storage proteins; Improving and altering the composition of starch and plant oils; Golden rice for β -carotene accumulation; Production of antibodies and pharmaceuticals in plants; Bio-safety concerns of transgenic plants.

AAB 3312: Enzyme Biotechnology in Food Processing

42 Hours

General Introduction – Introduction, historical developments, applications and business of enzymes; Enzyme safety, enzyme therapy, enzyme specificity, measurement and expression of enzyme activity, enzyme stability and denaturation; Regeneration of cofactors for biocatalysis-common cofactors required for biotransformation and their representative in situ regeneration methods: regeneration of NAD(P)(H), NAD(P)⁺, ATP/NTP, Sugar nucleotide, PAPS, Acetyl coenzyme A; Potential, selection and application of some of the important enzymes in food; Carbohydrases: amylases, glucoamylase, hemicellulase, and cellulase; Proteolytic enzymes: proteases; cathepsin, trypsin, papain, bromelain and ficin, rennin, pepsin, lipase: lipoxygenase, lipoxidase, etc; Oxidoreductase: glucose oxidase, catalase, peroxidase, polyphenol oxidase and ascorbic acid oxidase; Importance of enzymes in various food and agro process industry.

BEN 3315: Entrepreneurship

42 Hours

Types of business organisations. Agribusiness finance. Investment appraisal. Business environment. Characteristics of small and medium agribusinesses. Public and private organisations facilitating the setting up of an agribusiness in Kenya. Setting up of an agribusiness unit and development of a business plan. Marketing strategies for an agribusiness. Case studies. Entrepreneurship: generation of business ideas and innovation. Clustering.

Incubators. Regional outlook.

AAB 3314: Animal Health

42 Hours

An overview of animal health and diseases; Economic importance of animal diseases; Important viral, bacterial, parasitic, nutritional and metabolic diseases; Disease prevention and control, including biosecurity; Important notifiable diseases; Monitoring health and production in livestock; Animal health delivery services and institutions (regulation, policy and legislation); Health certification and trade; Emerging issues in animal health.

AAB 3313: Animal Breeding

42 Hours

Structure of animal breeding programmes; breeding objectives – definition and derivation of economic values from profit equations; selection index; gene flow, discounting and investment appraisal; theory and systems of breed 19ertilizati – inbreeding, crossbreeding etc; animal breeding schemes; performance and progeny testing; reproductive technologies – artificial insemination (AI), multiple ovulation and embryo transfer (MOET) and in-vitro 19ertilization (IVF); cloning

technology; mate selection; conservation of genetic resources; Performance and progeny testing; Nucleus breeding schemes; Importation of improved genetic material; Application of molecular and reproductive technologies in animal breeding.

YEAR 3 SEMESTER 2

AEE 3321: Agricultural Extension and Technology Transfer

42 Hours

Aims and purposes of agricultural extension; evolution of extension education to agricultural extension; principles of agricultural extension; basic concepts; justification for agricultural extension education in the developing countries; the communication process in agricultural extension; relevance of adult education in agricultural extension; adoption and diffusion of innovations; production of communication materials. Globalization, liberalization and the changing demands and role for agricultural extension; new horizons and extension modalities for research-extension-farmer-market-civil society linkages; information and communication opportunities for technology transfer and linkages; gender dimensions in agricultural extension and technology development and transfer; and policy, institutional and human resources development.

AAB 3321: Technological Applications in Food Processing 42 Hours

Recent trends in food processing; Techniques and applications of immobilized enzymes in food industry; Applications of glucose oxidase, catalase and pectinase in food processing; Single cell proteins for human food consumption; Biotechnology for natural and artificial flavor and fragrance production; Microbial biotechnology for food flavour production, oils and fats, Molecular High Intensity Low Calorie sweeteners; Essential oils; Sources and production of vitamins under controlled conditions; Safety issues related processed foods; parealization; nanotechnology; hardle technology; bio-preservation/ Natural preservation; High electric light pulse technology; Aseptic packaging/ vacuum packaging, biodegradable plastics, extrusion cooking.

AAB 3322: Dairy Process Biotechnology 42 Hours

Present status of dairy industry in Kenya; Physico-chemical properties of milk; Microorganisms associated with milk and milk products; Hygienic milk production- sources of contamination; of lactic and non-lactic acid bacteria in the preparation of various fermented milk products, classification of fermented milks; Health benefits of fermented milk and milk products and benefits derived through genetic improvement of starter culture; Industrial production/processing of fermented milks; Impact of biotechnology on dairy industry; Developments in probiotic foods; Use of Probiotics/Prebiotics/Synbiotics in fermented milk products; Application of bio additives in dairy processing; Application of biotechnology in dairy waste management; Role of enzymes in dairy processing.

AAB 3323: Greenhouse Technology And Protected Cultivation 42 Hours

Types of green house, importance, functions and features of green house. Scope and development of green house technology. Location, Planning of various components of green house. Design criteria and calculation. Construction material, covering material and its characteristics, growing media, green house irrigation system. nutrient management. Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment. Phytotrons, fertigation, roof system, containers and benches. Growing of ornamentals and vegetables under protected environment, physiology of plants in greenhouse, pest and disease control.

AAB 3324: Post Harvest Biotechnology of Cereals 42 Hours

Classification, chemical composition and nutritional values of food grains (cereals including millets, legumes and pulses); Anti-nutritional factors - chemistry and methods of their removal. Importance and scope of food preservation and storage; Food spoilages - causes and effects;

Principles and methods of food preservation and processing of food crops; Genetic engineering for value addition from economic point of view as well as nutritional composition - Transgenes for altered composition of oil/ starch/ amino acid/vitamins/antinutrients with their sources; Golden rice, high quality protein maize, hypoallergenic rice, wheat gluten modification; Biosol concept; Spheroplast fusion technology; Biocatalysts and worldwide food industry market.

AAB 3325: Biostatistics

42 Hours

Importance and application; Tabulation and classification of data; Frequency distribution and Graphical distribution of data; Data entry and analysis using EXCEL & SPSS; Measures of central tendencies, Mean, Median, Mode and their properties; Measures of Dispersion, Mean deviation, Variance, Standard deviation and coefficient of Variation, Correlation, linear and nonlinear regression; Parametric statistical methods: Students t-test; F-tests, ANOVA I; ANOVA II, Non parametric statistical methods: Chi square tests, sign test; Wilcoxon's Rank test, Kruskal –Wallis test. Correlation and Regression analysis; Concepts and problems on probability, Binomial, Poisson, Normal Distribution and their applications. Basic principles of design; Different models of data presentation with special reference to biological samples; Design and Analysis of Experiments; completely randomises, Randomised complete block, Latin square and Split-plot designs; Factorial experiments; Computer statistical programmes.

AAS 3321: Ruminant Animal Husbandry

42 Hours

Ruminant agriculture and production systems; Breeds of ruminants (cattle, sheep, and goats); Application of the principles of breeding; selection, nutrition, housing and health in the management of ruminant animals; Handling, processing and marketing of ruminant products.

AAB 3326: Animal Genetic Engineering

42 Hours

Introduction to recombinant DNA techniques using restricted enzymes; Cloning vectors, plasmid, phages, cosmids, and transposons; Genetic markers in farm animal classes of genetic markers; Microsatellite markers and their role in assistance in animal genetic resources; Single nucleotide polymorphism (SNPs) identification and genotyping; QTLs for candidate gene in animal production; Physical gene mapping and current status of gene maps of farm animals; Biohazards and safety aspects in genetic engineering; Physical and biological containment; Status and prospectus of transgenic animals and animal products.

AAB 3327: Bioinformatics

42 Hours

Introduction, Scope and application of Bioinformatics; Biological database (NCBI, ENSEMBL,

EBI, EXPASY, Genbank, AgriCol); Computers and biology, Online resources for bioinformatics; Simple pair wise alignment, Induction to Blast, FASTA, BLAST searching, BLAST and PHI/PSI-BLAST; Multiple sequence alignment tools for alignments (CLUSTALX, CLUSTAL W); Phylogeny, cladistics, and evolution, Phylogenetic trees; Introduction to Gene expression and microarrays, Introduction Micro array data analysis, Introduction to protein structure and structural databases, Molecular visualization, Basics of Proteomics; Concepts in Protein structure prediction.

YEAR 3 SEMESTER 3

AAB 3331: Industrial Attachment

480 Hours

An Industrial Attachment will be undertaken at the end of the 2nd Semester of the 3rd Year of study for twelve (12) weeks. Students will be examined in three stages as follows: Field supervision by academic staff of work undertaken by the student while on the industrial attachment (25%); oral presentation by the student upon return to the college on completion of the attachment (25%); and a written Report on the operation of the firm following the standard university report writing format (50%). The report should cover a theoretical background and identify a problem, causes, effects, and possible solutions and opportunities created on implementation of the intervention(s).

YEAR 4 SEMESTER 1

AAB 3411: Veterinary Biotechnology

42 Hours

Use of genetic engineering in vaccine development and production such as thermostable rinderpest vaccine, CCPP composite vaccine; Hybridoma technique; Recombinant DNA use in disease diagnosis; Embryo transfer technology; Development of recombinant vaccines; Nucleic Acid vaccines etc. Organized visits to areas of biotechnological interest will be covered during the course.

APT 3413: Horticultural Production

42 Hours

Economic importance of horticulture; Environmental factors affecting crop production and distribution; Physiological and genetic control of growth and development of vegetable plants and their products; Effects of nutrition, irrigation and other variables on crop performance and produce quality and presentation and of vegetables; Tropical and sub-tropical fruit production.

AAB 3412: Biotechnology in Horticulture**42 Hours**

Introduction to key concepts and definitions in plant biotechnology; Importance of Biotechnology in horticulture; Basic principles of plant tissue culture techniques including micropropagation and rapid multiplication techniques; In vitro and ex-vitro cultures; Case studies on selected genetically engineered horticultural plants; Handling and operation of biotechnology equipment and apparatus; Post harvest molecular biology - ripening (role of ethylene, climacteric vs. non-climacteric fruits), fruit softening (Pectinase and polygalacturonases), flavor fragrance and senescence; Genetic engineering plants for delayed ripening and better shelf life; Microbial contaminants and post-harvest pathology; Export Quality Standards; Biotechnology for recycling of horticultural waste as manures and livestock feed; Phytosanitation, HACCP, GM fruits and vegetables.

AAB 3413: Biotechnology of Ruminant Feed Utilization**42 Hours**

Anatomy of ruminant and non-ruminant digestive system; Mechanism of digestion and the role of rumen micro flora; Source of feeding stuff, nutritive value of common feedstuff; Rumen manipulation, defaunation and its effect on rumen digestion and feed utilization; Characteristics of good ration, nutritive ratio and starch equivalent; Computation of balanced ration for livestock; Feeding standards and thumb rule for feeding of Cattle - Calf, heifer, lactating cows, dry and pregnant animal; Single cell proteins in ruminant nutrition; Conventional and non-conventional industrial byproducts as cattle feed.

AAB 3417: Research Project I (Proposal Writing)

Each student will undertake problem solving research project in an area of his/her choice in Agricultural Biotechnology. The project will be conducted under supervision of teaching and technical staff; the students will prepare a research proposal guided by an appointed supervisor. Students are first required to search the literature relevant to their project and to plan their project work, including identifying the hypothesis to be tested.

AAB 3415: Food and Nutrition Security of GM Food Crops**42 Hours**

International aspects of the quality and safety of Foods derived from modern biotechnology; Application of ELISA for detection of toxins in food; Biosensors for food quality Assessment; Malnutrition, consequences, causes, prevention and control; Applied community nutrition; Food safety and food faddism; Safety testing for toxicity, allergenicity, anti nutritional effects, Native

toxins and toxins produce during storage, health hazards.

AAB 4416: Biopesticides and Biofertilizers

42 Hours

Definition of Biofertilizers, Bacterial and fungi suspensions/inoculants as biofertilizers and biocontrol agents to fight insect pests, weeds or diseases in plants; Atmospheric nitrogen fixing soil bacteria (Rhizobium, Azotobacter, Acetibacter) and several cyanobacteria; Mechanism of soil bacteria and cyanobacteria for enhanced nitrogen fixation; Role of water fern Azola as biofertilizers; advantage of biofertilizers over chemical fertilizers; activity to control insect pests. Free – living and symbiotic nitrogen fixers; nif genes to other soil micro-organism; Endophytic diazotrophs; nif gene transfer; Nodulation by Rhizobium; Rhizobium management; Rhizosphere engineering. Biopesticide definition: Types (Bioinsecticides and biofungicides); Protein antipest materials such as Bacillus thuringiensis; Development of biopesticides, advantages over chemical pesticides (biodegradability, specificity). Antibiosis and allelopathy.

YEAR 4 SEMESTER 2

AAB 3421: GMOs, Biosafety & Bioethics

42 Hours

Definition, Biosafety concerns. Biosafety regulations in various countries, International agreements related to biosafety; Convention on Biological Diversity (CBD) and Cartagena protocol on Biosafety; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; Climate change and conservation of plant genetic resources; Global efforts for management of crop genetic resources; Ethical issues in biotechnology. Regulatory framework of biosafety in Kenya; Role of KEPHIS and NBA. Guidelines for recombinant DNA technology; Status, prospectus and concerns of GM crops, Biosafety of environment and human health; Guidelines for research in transgenic plants and drugs. Social and ethical issues; Biosafety issues related to genetically modified organisms (GMOs); Gene contamination; Biosafety and Risk assessment of GMOs; Public perception. Important genes of agronomic interest; Current trends in finding useful genes; Traceability, Legislative aspects; Biotechnological products in Kenya; Quality parameters and quarantine procedures of export.

AAB 3422: Current Topics in Agricultural Biotechnology

42 Hours

Current topics in the scientific literature and the media on agricultural biotechnology; New approaches to breeding; Embryo transfer & technology; Stem cell Research; Cloning and transgenic animals; Use of gene technologies in animal breeding; Indigenous food crops

“Orphaned Crops” production – the role of agricultural biotechnology.

AAB 3423: Intellectual Property Right (IPR) and Patents 42 Hours

IPR: Meaning, Nature and Scope of IPR; History of IPRs; Copyrights, Patents, Trademark, Geographical Indications; Recent amendments in Kenyan acts and regulations related to IPR. Product patent and Process Patent; Recent developments in registration of inventions and protections of IPR; WIPO and its role, WTO regimes, GATT agreement and its impact on agriculture and biotechnology; Trade Related Aspects of Intellectual Property Rights (TRIPS); Current status of patenting of gene and genetically engineered organisms in Kenya and world; Patent filing-opposition-retrieval.

AAB 3417: Research Project II (Research) 42 Hours

Each student will undertake problem solving research project in an area of his/her choice in Agricultural Biotechnology. The project will be conducted under supervision of teaching and technical staff; the students will prepare a research proposal guided by an appointed supervisor and continue to conduct the experiment, write a report and give an oral presentation.

AAE 3428: Agricultural Project Management 42 Hours

Rural development; relationship between agricultural and rural development; economic and social projects; ‘basic needs’ approach; Project and programme project cycle, identification and preparation; target groups in project preparation; construction of databases; techniques of preparation; Methods of project formulation; costs and benefits; methods of appraisal; basic techniques of accounting and financial control for production and social projects; choice of technology; programme planning and appraisal; implementation and management; time and cost control; organizational design.

AAE 3423: International Agricultural Trade 42 Hours

International economics and its main themes; Theory of international trade: Comparative advantage, the Ricardian model: Specific factors and income distribution, resources and trade; The Heckscher-Ohlin model: Economics of scale and imperfect competition and international trade; International trade policies: tariffs, non-tariff instruments; Political economy of trade policy; Cases for and against free trade; Trade policy in developing countries; Import substitution; Trade liberalization; Foreign market access and north-south debate; International

negotiations and trade; Regional integration agreements; General agreement on Trade and Tariffs and World Trade Organization; Current state of trade links and obstacles in the greater horn and Africa.

AAE 3427: Farm Management

42 Hours

Definition and scope of management; Unique characteristics of farm management: Planning, implementation and control; Basic economic principles in the context of farm management; Returns to capital, labour, management and owners' equity; Personnel management; Labour laws and regulation; Motivation and group dynamics; Measures of risk: Criteria for decision making under risk and uncertainty; Farm planning techniques; Farm enterprise studies; Performance analysis of the farm business; Value chain and value addition of agricultural products; Market driven agricultural production; Access to markets and market information; Theories of production/expansion path; Cost of production and cost curves.

