purification of drinking water chemical and bacterial. Photodynamic therapy. Dye sensitized solar cells.

APCH 433: ***Analytical Biochemistry and Sensors*** **3Cr.Hr. (L2+P 3)**

Prerequisite CHEM 331

Understanding the basics of analytical biochemistry methods. Applications of analytical techniques to biological samples.Gaining the ability to select and efficiently use analytical methods for the analysis of biological samples. Chemical sensors and biosensors. Understanding of the basic concepts of sensors and their fundamental and real world applications.

Practical part focus on giving students hands on experience in analysis of biological samples using instrumental methods of analysis. Further students will gain knowledge in preparation of simple chemical sensors and utilized such sensors in chemical analyses.

APCH 440: ***Applied Physical Chemistry (E)*** **2Cr.Hr. (L2+P 0)**

Prerequisite: (-)

Part 1: Technology of Building Materials: Blast-furnace slag, formation, treatment and use in composite cements, factors affecting suitability for use in a composite cements, hydration chemistry of slag cement, X-ray microanalysis, stoichiometry of slag cement hydration, supersulphated cement. Pulverized fuel ash, low in CaO, properties, the nature of the pozzolanic reaction, stoichiometry of pfa cement hydration. Natural pozzolans, properties, hydration reactions. Microsilica, properties, hydration reactions. Other mineral action, class-C fly ash, other pozzolanic or hydraulic additions, calcium carbonate and other fillers. Pore structure and their relation to physical properties, porosities and pore size distributions.

Part 2: Molecular spectroscopy: Principles of electronic- infrared - nuclear magnetic resonance and mass spectroscopy – relation between molecular structure of organic compounds and electronic, IR, ^{1}HNMR,^{13}CNMR and mass spectra- application of spectroscopic methods for elucidation of molecular structure.

APCH 441: ***Applied Physical Chemistry (3):*** **2Cr.Hr. (L2+P 0)**

Prerequisite: APCH 342

Part 1: Photochemistry: Definitions, light and dark reactions, nature of light, basic laws of photochemistry, sequence of processes in photochemical reactions, quantum yield, determination of intensity of light. Absorption of radiation: absorption and emission processes, spectroscopic nomenclature, general rules for the order of energy terms, selection rules for optical transition, Franck-Condon principle. Radiative transition: luminescence, fluorescence, phosphorescence, chemiluminescence. Energy transfer and charge transfer: energy transfer, excimer and exciplex, oxygen quenching, heavy atom quenching, kinetics of quenching, charge transfer and electron transfer, flash photolysis, laser.

Part 2: Catalysis: Introduction: Criteria of catalysis, homogeneous catalysis, the intermediate compound formation theory, examples, catalytic decomposition of H_2O_2, acid base catalysis, enzymatic catalysis, heterogeneous catalysis, steps of catalytic action, true and apparent activation energies, diffusion-controlled and kinetically controlled reactions, surface area and pore structure of solid catalysts and their role on both diffusion-controlled and kinetically controlled reactions, chemisorption in catalysis: theories and types, kinetics and mechanism of heterogeneous catalytic reactions, models of active centers, some applications in industry.

APCH 442: ***Applied Physical Chemistry (4)*** **2Cr.Hr. (L2+P 0)**

Prerequisite: APCH341

composites, particulate composites, filled composites, laminar composites. Glass composite materials: the glassy state, structure and method of investigation, thermodynamic characteristics of glass. Glass like materials: heterophase glasses, photochromic glass and luminescent solids, multiphase organo-silicate materials, porous glasses, phosphate and borate coating materials, glass ceramic materials and glazes, segregations of ultra-disperse metal particles on surface support. Methods of investigation of composite materials.

APCH 446:*Practical Applied Physical Chemistry* **1 Cr.Hr. (L0+P 3)**
Prerequisite: APCH344
Experiments on advanced applied physical chemistry

APCH 448:*Applied Physical Chemistry (D)* **2Cr.Hr. (L2+P 0)**
Prerequisite: APCH441
Part 1: Applied Photochemistry: Atmosphere (density, pressure, temperature, change) and composition of atmosphere and layers of atmosphere, Stratosphere chemistry, Ozone, ozone perturbation consequence and Antarctic ozone hole, introduction of photosynthesis and Z-scheme of photosynthesis, Monochromatic vision and color vision, Black-white photography and color photography, Photochromic and photo medicine, Laser (mechanism) and Type of Laser, Photocatalytic treatment of waste water.
Part 2: Applied Catalysis: Reactor design: material balance, types, performance and kinetic equations, industrial catalyst design, resistances to chemical reactions on solid catalysts, catalyst deactivation, supported catalysts: preparation, theory of active ensembles, structure sensitive and structure insensitive reactions, mobility and sintering, hydrogen-spillover, applications in practice: in petroleum, petrochemical and environmental fields, Grand families of catalyst materials, e.g. zeolites, heteropoly acids, etc.

APCH 450:*Essay or Research Project* **1 Cr.Hr.**
(L1+P 0)
Prerequisite: (pass 75% of credit hours)
Each student writes a professional essay about a specific organic chemistry subject. Students search chemical abstracts, chemistry databases, and internet sites to collect materials relevant to the tackled research subject.

APCH 451:*Essay or Research Project* **1 Cr.Hr.**
(L1+P 0)
Prerequisite: (pass 75% of credit hours)
Each student writes a professional essay about a specific (non-organic) chemistry subject. Students search chemical abstracts, chemistry databases, and internet sites to collect materials relevant to the tackled research subject.

Course Contents of Botany Department

BOTA 401: Principle of Enzymology and its Technological Applications **3 Cr. hr.**
(L2 + P3)
Prerequisite: (BOTA --)
An introduction to the course, aims and benefits. Structure and diversity of amino acids, three dimensional structure of protein and quaternary structures. Enzymes as biological catalysts. Physical and chemical nature of enzymes. Enzyme cofactors; modes of their actions. Proenzymes and

isozymes. Mechanism of enzyme action; reactive sites, enzyme substrate complementarities, key & lock model and induced fit model. Energetic bases for the activated state and transition state. The types of catalytic mechanisms that enzymes have been employed; acid base catalysis, covalent catalysis, proximity and orientation effects, metal ion catalysis, preferential binding of the transition state complex, electrostatic catalysis. Specificity of enzyme action – Michaelis – Menten Equation. Enzyme kinetics through studying factors affecting enzyme activity; substrate concentration, enzyme concentration, pH of the reaction medium, temperature, water content of the reaction medium, presence of activators or inhibitors, accumulation of end products, feed back inhibition and regulation of metabolism, oxidative state of the enzyme. Classification and nomenclature of enzymes; (oxidoreductases – transferases – hydrolases – lyases – isomerases and ligases.

BOTA 402: Metabolism and Biological Energetics 3 Cr. hr. (L2 + P3)
Prerequisite: (BOTA --)

1- Carbohydrate metabolism:

Photosynthesis; Physical nature of light, photosynthetic apparatus, Pigments involved in photosynthesis and their absorption and action spectra, Dual role of carotenoids in plants – Red drop and Emerson enhancement effect.

I- light reactions. Proposed mechanisms of ATP formation. II- Dark reactions (Calvin cycle) Regulation of CO_2 fixation and Calvin cycle enzymes. Ferrodoxin – thioredoxin system and regulation of the Calvin cycle. Sucrose and starch biosynthesis as competitive processes. Photorespiration. Difference between C_3 and C_4-plants – CO_2 concentrating mechanisms in C_4 plants - Crassulacean acid metabolism (CAM)

Respiration: Glycolysis, anaerobic respiration, fermentation, Krebs cycle. Efficiency of respiration. Electron transport system in mitochondria and energy coupling – Hexose monophosphate shunt. Gluconeogenesis – Regulation of respiration, Pacemakers of glycolysis, gluconeogenesis and Krebs cycle. Uncoupling agents – Cyanide resistant respiration (alternative respiration)

2- Lipid and nitrogen metabolism:

a. Lipid metabolism

An introduction, importance, distribution, structure and characteristics of lipids. Catabolic pathways of neutral acyl lipids, β- oxidation pathway. Cytoplasmic shuttles, α-oxidation pathway. Anabolic pathways of neutral acyle lipids. Biosynthesis of saturated and unsaturated fatty acids. Metabolic pathways of polar lipids (PL). Catabolic and anabolic pathways of PL. Glyoxylate cycle.

b. Nitrogen metabolism:

Introduction of nitrogen fixation. Factors required for nodule formation in leguminous plants. Mechanism of nitrogen fixation. Assimilation of nitrate and its control. Biosynthesis of amino acids. Degradative pathways of amino acids. Types & biological function of proteins.

3- Biological energetics:

1st and 2nd laws of thermodynamics and free energy changes. Endergonic and exergonic reactions and energy coupled reactions. Factors determining the direction of metabolic reactions. Effect of ionization on cell energetic reactions. Arrangement of energy relation in plants and the plant as an open system. Electrochemistry and energy conservation in plants. Oxidation - reduction processes and free energy changes. Coupling of electron flow with the synthesis of ATP. Energetics of chemical reactivity and catalysis.

BOTA 403 : Protein Engineering: Trafficking and Interactions 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 207)

Chemical and physical interactions in bio-molecules- Types of protein inter and intra- interactions- Protein: protein- protein: DNA- protein: RNA- Protein trafficking from origin to final destination- Objectives for protein engineering- Techniques for protein engineering- Some case studies of protein engineering.

BOTA 404: Flora of Flowering Plants + Flora of Mosses 3 Cr. hr. (L2 + P3)
Prerequisite: (BOTA 304)
1- Flora of flowering plants (one hr lecture)
Introduction, Definition of flora, methods of studing flora – History of Egyptian flora – Herbaria; Definition – Historical introduction about the herbaria – Jops of herbaria - studing how to prepare herbarium sheet for conservation at herbarium – Arrangement of herbarium sheets – Types of vegetation and plant communites in Egypt – Phytogeographical regions in Egypt – protectorates.
2- Flora of mosses (one hr lecture)
Introduction about Bryophytes - Distribution and dispersal of mosses- Historical background of studying moss flora in Egypt – Ecology and distribution of mosses in Egypt – Bryogeography and floristic elements in Egypt. Phytogeographic territories of Egypt. Floristic composition – distribution of taxa and floristic features of territories – Key of mosses recorded in Egypt – Bryoflositic regions of the world – Conservation of Bryophytes – Threates of Bryohytes.

BOTA 405: Algal Biotechnology 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 306)
Algal biotechnology and industrial production of antibiotics, organic chemicals, pigments, biodiesel and phycocolloids. Algae for the recovery of metals. Algae for the improvement and maintenance of environmental quality. Genetic engineering of cyanobacteria to enhance biohydrogen production from sunlight and water.

BOTA 406: Applications of Plant Ecology 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 312)
Concepts of the various ecological resources including: (1) renewal, (2) nonrenewal, (3) dynamic and stable. Productivity of natural ecosystems. Dangers underlying ecosystems and ways of their prevention. Depletion of ecological resources, reasons and means of its prevention - Definition and classification of arid lands – Water and plant habitat – Dams and their role in water protection in arid regions – Wet and dry agriculture – Evaluation of arid regions and development methods – Arid lands uses – Production blockers in arid regions – Future energy and Arab arid lands use economics.

BOTA 407: Modern Classifications (Molecular taxonomy) – Medicinal and Aromatic Plants (Flowering and Non-Flowering Plants) 3 Cr. hr. (L2 + P2)
Prerequisite: (BOTA 304)
a) Modern classifications: Introduction, the scope of taxonomy Traditional plant classification system - Development of system of plant taxonomy: Artificial, Natural and phylogentic classification - Sources of taxonomic informations (Taxonomic evidence * Structural information; reproductive & vegetative characters, morphological and anatomical) * Chemical informations (origin & nature of chemotaxonomy, Cpd useful in plant taxonomy) * Cytological characters (chromosomal evidence) * Ecological and geographic evidences.
b) Medicinal and aromatic plants: Historical introduction – Public medicine – taxonomy of Medicinal plants – Importance of herbal medicine – examples of drugs obtained from different parts of the medicinal plants from, roots, bark, stems, leaves, flowers and seeds – Examples on aromatic plants – Methods of Extraction distillation of volatile and nonvolatile oils – the importance of aromatic plants – medicinal and aromatic plants in Sinai peninsula.

BOTA 408: Genetic Engineering 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 305)
Chemical composition of the DNA molecule - Types of DNA vectors - DNA Transformation methods - Screening methods for DNA transformants - DNA manipulative enzymes; Restriction enzymes;

Ligase; Alkaline phosphatase - Polymerase chain reaction (PCR) and its applications - RNA blot analysis - PCR cloning - Study of regulation of gene expression via reverse transcriptase PCR - DNA Microarrays.

BOTA 411: Stress Physiology and Antioxidant System in Plants 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA --)
1. Stress Physiology
Water deficit and drought tolerance - Heat stress and heat shock - Chilling and freezing stress - Salinity stress - Flooding stress and oxygen deficiency.
2. Anioxidant system in plants
Free radicals – Reactive nitrogen species (RNS) – Reactive oxygen species (ROS). Sites of ROS production in plant – Biological damage caused by ROS. Enzymatic antioxidants: superoxide dismutase (SOD), Catalase (Cat), Ascorbate peroxidase (APX) and Glutathione reductase (GR). Non-enzymatic antioxidants: Ascorbate, Reduced glutathione (GSH), Tocopherols, Carotenoids, Phenolics, Proline, Polyamines, Flavonoids and Hydroquinones. The redox cycling of ascorbate in the chloroplast (Halliwell – Asada pathway).

BOTA 412: Simulation Modeling of Macromolecules 1 Cr. hr. (L1 + P0)
Prerequisite: (BOTA --)
Introduction to Biomolecules - Computer Simulations as a new tool for Scientific Research - Problems in computational biology - Basics of nucleic acid structure and Protein Architecture - Computer Simulations of biomolecules - Foundations of biomolecular simulations - Modeling interactions in proteins - Computation of non-bonded energy terms - Simulations of molecular dynamics.

BOTA 413: Numerical and Cladistics Taxonomy 2 Cr. hr. (L2 + P0)
Prerequisite: (BOTA 304)
Objectives, General considerations – Working steps in numerical taxonomy – The estimation of taxonomic similarity – Taxonomic structure - Clustering methods - Single linkage clustering - Complete linkage clustering - Average linkage clustering - Unweighted Pair-Group Method using Arithmetic (UPGMA) - Optimality criteria: cophenetic correlations –Dealing with taxonomic characters – Binary characters – Qualitative and qualitative multi-states – Suitable no. of characters – Inadmissible characters – Character weighting – Coding and scaling of characters in numerical taxonomy - Basics of cladistics analysis: Plesiomorphic and apomorphic characters – Construction of cladogram: Henning argumentation; Wagner tree – Cladogram terms – Evaluating cladograms - Searching for most parsimonious tree - Weighting of characters in cladistics analysis – Polarity decisions – Coding in cladistics – Coding of linear multi states – Coding of branching multistate: non additive binary; mixed coding.

BOTA 414: Management of Wildlife 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 312)
Approaches to wildlife management (Preservation, Conservation, Management)- Habitat diversity - Decision making (Who makes decisions, Making good decisions) – Wildlife ecology (Mutualism, Commensalisms, Competition, Predation, parasitism, herbivoury) -Wildlife Habitats: Tropical Savannah - Temperate grassland - Tundra - Semi-desert - Desert - Man made biomes -Wet biomes (Mangrove) - Wildlife management techniques: Habitat modification - Fire - Vegetation management - Predator control - Habitat features - Population monitoring -Control of pest or undesirable wildlife species – Wildlife Management Law and Administration: Policy and Wildlife law - International environmental law - Domestic/National law - Sources of legislation - Environmental ethics - Authorization and enforcement

BOTA 415: Plant Biotechnology 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 307)
Definition - Types of biotechnology and examples of biotechnology products – History - Food biotechnology - Agricultural biotechnology - Environmental biotechnology - Medical Biotechnology -

Bioinformatics and statistics - Cell tissue culture: Introduction; Definition and technologies; Plant cell & tissue culture technologies: A brief description, technology and potential application of organ culture, meristem culture, anther/pollen culture, callus & suspension cultures and protoplast culture; Plant propagation; Regeneration through meristem and callus cultures; Somatic embryogenesis: production, preservation and use of somatic embryos as propagules; Artificial seeds and automation of somatic embryo production: Principles, technology of automation and the application; Embryo culture; Haploid plant production; Cryopreservation: Storage of germplasm; Protoplast culture; Somatic hybridization; Induction & utilization of somatic variants; Secondary metabolite production through cell cultures: Principles and the technology, pharmaceutical, pigments, other natural products and beverage production; Commercialization of tissue culture technology: Concept of commercialization and the need, design of typical tissue culture laboratory and its management.

BOTA 416: Applied Aspects of Archegoniates **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 204)
Introduction about Archegoniates – General characters of Bryophytes, Pteridophytes and Gymnosperms – Physiological characters of Bryophytes – Tissue culture of Bryophytes – Chemotaxonomy of Bryophytes – Biological active substances isolated from Bryophytes – Medical uses of Bryophytes, Pteridophytes and Gymnosperms - Agricultural applications of Bryophytes, Pteridophytes and Gymnosperms – Uses of Bryophytes as Bioindicators and Biomoniters of pollution - Ecological uses of Bryophytes – Uses of Bryophy, Pteridophytes, Gymnosperms in industry – Economical uses of Archegoniates.

BOTA 418: Metabolism of Secondary Plant Products **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA --)
Potential plant enemies – Plant surface protectants. Differences between 1ry and 2ry metabolites - Major pathways of 2ry metabolites and their interrelationships with 1ry metabolism - General function of secondary metabolites.
Groups of 2ry metabolites.
Terpenes, phenolics and nitrogen – containing compounds.
Terpenes: Biosynthetic pathways: mevalonate pathway and methylerythritol phosphate (MEP) pathway – Role of terpenes in growth and development – volatile terpenes and non-volatile terpenes – saponins and their functions.
Phenolic campounds: Biosynthesis of phenolic compounds from phenylalanine including coumarins, benzoic acid derivatives, lignin, anthocyanins, isoflavones, condensed tannins and other flavonoids begins with phenyalanine- Functions of phenolic compounds.
Nitrogen containing compounds: major types of alkaloids, their amino acid precursors, example for each, their functions – cyanogenic glycosides – Glucosinolates and volatile toxins – Non-protein amino acids and their toxic effect.

BOTA 420: Embryology **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA --)
Flower, Microsporangium - Male gametophyte (Development and morphology) - Mega sporangium - Female gametophyte - Pollination & fertilization - Sexual incompatibility - Endosperm - Embryony - Polyembryo - Apomixis - Seed: Development, coat and importance - Embryology in relation to taxonomy.

BOTA 421: Enzymology **3 Cr. hr. (L2 + P3)**
Prerequisite: (BOTA --)
Course aim, needs, discovery of enzymes. Introduction and occurrence, function and use of enzymes in chemical industry. Structure and diversity of amino acids. The primary, secondary (α-helices, β-sheets), super-secondary, tertiary and quaternary structures of protein. Physical and chemical nature of enzymes, enzyme properties (catalytic efficiency, specificity and affinity between enzyme and substrate, regulatory power of enzymes). Mechanism and strategies of enzyme action. Enzyme

cofactors (modes of action, structural moieties, reactive sites, and functions of vitamin and non-vitamin derived coenzymes, role of metal ions as cofactors). Enzyme kinetics (the definition of kinetics and the order of the reaction, Michaelis-Menten kinetics, enzyme association and dissociation, the MM equation and the MM plot). Enzyme inhibition (types of enzyme inhibition and enzyme inhibitors, examples of reversible and irreversible inhibitors, applications of enzyme inhibitors). Nomenclature and classification of enzymes according to the IUBMB, giving examples of main enzymes in metabolism. Enzyme calcifications (oxidoreductases, transferases, hydrolases, lyases, isomerases and ligases).

BOTA 422: Plant Metabolism (Carbohydrate, Lipid and Nitrogen Metabolism) 3 Cr. hr. (L2 + P3)

Prerequisite: (BOTA --)

1- Carbohydrate metabolism:

(One hour lecture and one and half hours practical per week)

Photosynthesis; Definition, Physical nature of light, Function of photosynthetic apparatus, Pigments involved in photosynthesis and their absorption and action spectra, Dual role of carotenoids in plants – Red drop and Emerson enhancement effect.

I- light reactions including non-cyclic electron transport, cyclic electron transport, pseudocylic electron transport (Mehler reaction), reduction of $NADP^+$, photolysis of water, formation of ATP. Proposed mechanisms of ATP formation. II- Dark reactions (Calvin cycle) Regulation of CO_2 fixation and Calvin cycle enzymes. Ferrodoxin – thioredoxin system and regulation of the Calvin cycle. Sucrose and starch biosynthesis as competitive processes. Photorespiration.

Respiration: Glycolysis, anaerobic respiration, fermentation, Krebs cycle. Efficiency of respiration. Electron transport system in mitochondria and energy coupling – Hexose monophosphate shunt (Pentose phosphate pathway). Gluconeogenesis – Regulation of respiration, Pacemakers of glycolysis, gluconeogenesis and Krebs cycle.

Uncoupling agents – Cyanide resistant respiration (alternative respiration)

2- Lipid and Nitrogen metabolism:

One hour lecture and one and half hours practical per week for one term

a. Lipid metabolism

An introduction, importance, distribution, structure and characteristics of lipids. Catabolic pathways of neutral acyl lipids, β- oxidation pathway. Cytoplasmic shuttles, α-oxidation pathway. Anabolic pathways of neutral acyle lipids. Biosynthesis of saturated and unsaturated fatty acids. Metabolic pathways of polar lipids (PL). Catabolic and anabolic pathways of PL. Glyoxylate cycle.

b. Nitrogen metabolism:

Introduction of nitrogen fixation. Factors required for nodule formation in leguminous plants. Mechanism of nitrogen fixation. Assimilation of nitrate and its control. Biosynthesis of amino acids. Degradative pathways of amino acids. Types & biological function of proteins.

BOTA 423: Fossil Plants 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA 213, 322)

Introduction of fossil plant - The objectives of fossil plant – Preservation - Kinds of fossil plants and their techniques - Absolute dating - System of nomenclature of fossil plant - Fossil plants and palaeoclimatology - Fossil plants and palaeoecology - Fossil flora of Egypt.

BOTA 424: Flora – Pharmacognostical Plants 3 Cr. hr. (L2 + P3)

Prerequisite: (BOTA 216)

Flora: (One hour lecture and 1.5 hours practical per week).

Introduction, Definition of flora - methods of studing flora – History of Egyptian flora – Herbaria; Definition – Historical introduction about the herbaria – Jops of herbaria - studing how to prepare

herbarium sheet for conservation at herbarium – Arrangement of herbarium sheets – Types of vegetation and plant communites in Egypt – Phytogeographical regions in Egypt – protectorates.

Pharmacognostical plants: (One hour lecture and 1.5 hours practical per week).

Introduction + principles of pharmacognosy; pharmacognosy and modern medicine- Classification of vegetable drugs – Origin of drugs – cultivation of medicinal plants – preparation of drug from plant to pharaceuticals – adulteration of drugs and detection of adulterants – Active constituents (secondary metabolites) of various drugs – Dusting powder, fibers and surgical dressing – Leaves, flowers, barks and wood drugs – Seeds, fruits, subterranean drugs and root drugs.

BOTA 426: Amplification Techniques of DNA by PCR 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA 323)

What is PCR? - The Procedure – Why polymerases? – Setting up a polymerase chain reaction laboratory – Random or specific targets – Limitations of PCR reactions – Types of PCR (IUnverse PCR – Anchored PCR – Nested PCR – Real-time PCR- Applications of PCR in molecular identification (e.g. Molecular Archaeology, Molecular Epidemiology, Molecular Ecology, DNA fingerprinting, Drug discovery) – Applications of PCR in sequencing (e.g. Genomic cloning, Bioinformatics) – Applications of PCR in genetic engineering 9e.g. Site-directed mutagenesis, Gene expression studies).

BOTA 427: Physiology of Seed Germination and Propagation 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA 321)

Physiology of seed germination (1/2 hr theoretical per week)

Chemical composition of seeds – Factors affecting germination; viability and life span of seeds and exteranal factors affecting germination – Dormancy – germination inhibition and stimulation – Secondary dormancy – Possible causes of dormancy – Germination stimulators – Hormones in germination – Metabolism of germinating seeds; changes in storage products during germination, breakdown and metabolism of storage products and synthesis of nucleic acids and proteins – Effect of natural growth substances (gibberellins, cytokinins, ABA and the ratio between gibberellins and abscisic acid) – The effect of coumarin and thiourea.

Vegetative propagation (1/2 hr theoretical per week)

Macropropagations: Adventitious root formation in different plant organs – The commercial importance of adventitious rooting – Plant propagation protocols and the effect of phytohormones and certain growth regulators as inducers – Histological, biochemical and molecular markers of cellular competence for adventitious rooting.

Micropropagations: Choosing stock plant of high propagated lines using different genetic and physiological criteria - Explant selection and sterilization - Media manipulation to obtain proliferation and rooting - Acclimation, and growing on of liners - Commercial mass production.

BOTA 429: Applied Aspects of Archegoniates and Fossil Plants 2 Cr. hr. (L2 + P0)

Prerequisite: (BOTA 322)

Applied aspects of Archegoniates: Applied aspects of Archegoniate in Medicine - Agriculture - Wood industry - Food chemistry.

Application of fossil plants: Determining Palaeoclimate from fossil plants - Palaeoecology: Plants in their environment - Palaeopalynology - Evolution of plant groups.

BOTA 430: Secondary Metabolism in Plant 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA --)

Potential plant enemies – Plant surface protectants. Differences between 1ry and 2ry metabolites - Major pathways of 2ry metabolites and their interrelationships with 1ry metabolism - General function of secondary metabolites.

– Groups of 2ry metabolites.

Terpenes, phenolics, nitrogen containing compounds, their biosynthetic pathways and their functions.

BOTA 431: Introduction to Embryology 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA --)
Flower, Microsporangium - Development and morphology of male and female gametophytes and sporangium - Pollination, fertilization and Sexual incompatibility - Embryology in relation to taxonomy - Endosperm – Embryony - Polyembryo & Apomixis - Seed: Development, coat and importance.

BOTA 432: Biotechnological Aspects of Algae 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 325)
Algal biotechnology – algae in field of biochemistry – Algal culturing and isolation - Overview about the beneficial and hazard effects of algae - The beneficial issue will cover the medicinal importance of algae through its therapeutic effects for treating some diseases - The role of algae as indicators to water quality and the efficient algae using in sewage treatment - The hazard effects caused by algae, will be mentioned in a part of nuisance algae and problems relevant to microscopic, filamentous and macroscopic algae.

BOTA 434: Application of Plant Tissue Culture in Stress Tolerance 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 321)
Stress tolerant plants could be produced *in vitro* through some applications of plant tissue culture, these include; *in vitro* selection of soma-clonal variant cells. Protoplast technology which includes; a- the micro-injection of protoplasts with a gene having the desired character, b- the co-cultivation of protoplast with a plasmid carrying the gene responsible for stress tolerance and c- the production of somatic hybrid through protoplast fusion between cultivated and wild species having the stress tolerance. Another biotechnological application is "Transformation" production of transgenic plants.

Course Contents of Zoology Department

ZOOL 401: Parasitology 3Cr.Hr. (L2+ P2)
Prerequisite: ZOOL 201
Principles and concepts in parasitology: animal associations, habitats of parasites, parasites distribution, types of hosts, types of parasites, types of parasites life cycles, host-parasite relationships, sources of infection with animal parasites, modes of infection, zoonoses, host specificity, parasite epidemiology and control, parasite diagnosis using different techniques, adaptation and evolution of parasitism. Also, this course will cover the basic biology, identification, pathology and treatment of some important parasitic organisms (protozoa, helminths, and arthropods) of medical and veterinary importance.

ZOOL 402: Aquatic Ecology Cr.Hr. (L2+P 2)
Prerequisite: ZOOL 201
Physical, chemical, and biological processes occurring in lakes, streams, and wetlands, the basic knowledge of ecology and chemistry, the physical and chemical aspects of aquatic systems, the life cycles and adaptations of aquatic organisms, types of marine habitats, effects of environmental factors on aquatic fauna and marine and freshwater food chains, bioenergetic relations, biotic diversity, productivity, and water pollution, the impacts of human activities on aquatic ecosystems.

ZOOL 403: Neurophysiology and muscles 3 Cr.Hr. (L2+P3)
Prerequisite: ZOOL 306

Classification and functions of neurons and glial cells – Electrical activity in nerve fibres – Electrical and chemical synapses – Types of neurotransmitters and chemically regulated gates – EPSP, IPSP, synaptic integration – The brain and spinal cord – The somatic division – The autonomic division – Control of involuntary effectors – Types of sensory receptors – Structural organization of skeletal muscles – Neuromuscular junction and motor units – Stimulation, regulation and mechanism of contraction – Twitch, summation and tetanus – Isotonic contractions – Slow and fast twitch fibres – Energy requirement and muscle contraction – Muscle spindle apparatus – Cardiac and smooth muscles' contraction.

ZOOL 404: Comparative Anatomy **3 Cr.Hr. (L2+ P2)**
Prerequisite: ZOOL 202
Protochordates and the origin of vertebrates, concepts relevant to modern vertebrate morphology, integumentary system (epidermis, dermis, and skin derivatives), skeletal system (chondrocranium, osteocranium, vertebrae, girdles and limbs), circulatory system (heart, arterial and venous systems), urinogenital system (kidneys and their ducts, ovary, testis, male and female genital ducts and fate of the cloaca in placental mammals). At the end of the course the student gain an understanding of structural, functional, and evolutionary relationships among anatomical parts within and between major taxa of vertebrates.

ZOOL 405: Respiration and Excretion **1 Cr. Hr. (L1+P1)**
Prerequisite: ZOOL 309
Respiration: introduction to the physiology of respiration, structure of the respiratory system, physical aspects of ventilation, mechanics of breathing, gas exchange and transport, regulation of breathing.
Excretion: functional organization of the kidneys, urine formation and micturition, glomerular filtration rate, renal plasma clearance, renal blood flow, renal control of electrolytes, acid-base balance, diuretics, hormonal control of urine volume and composition, renal failure and dialysis.

ZOOL 406: Histology **2 Cr. Hr. (L1+P 2)**
Prerequisite: ZOOL 208
Histological and ultrastructure of the digestive system: membranes of the oral cavity, tongue, teeth, parts of the digestive canal, the accessory glands - The urinary system: nephron, collecting tubules, ducts, Juxtaglomerular apparatus - The mononuclear phagocytic system – The hematopoietic organs – The lymphoid system – The endocrine glands - The nervous system: brain and spinal cord, ganglia, sense organs.

ZOOL 407: Scientific Article **1 Cr.Hr. (L1+P1)**
Prerequisites (-)
Library and web search in selected topics in Zoology – Structural writing of scientific essays and reports – The rules of report writing – Components of a formal report, readability index, unity and coherence – Stages of report writing: investigation, planning, writing, and revising – The elements of introduction as well as material and methods, how to write a text and build a discussion, how to classify references – Using headings, charts, and graphs.

ZOOL 408: Histology and immunohistochemistry 4 Cr. Hr. (L3+P 3)
Prerequisite: ZOOL 208
Histological and ultrastructure of the following systems; the digestive system: structures inside the oral cavity, the digestive canal, the accessory glands - The urinary system: nephron, collecting tubules, ducts, Juxtaglomerular apparatus - The mononuclear phagocytic system – The hematopoietic organs – The lymphoid system – The endocrine glands - The nervous system: brain and spinal cord, ganglia, sense organs. Introduction of Immunohistochemistry – Basic structure of the antibody, storage of antibodies, Immunohistochemical techniques (principle, tissue handling and preparation, sample labeling, immunostaining, sample visualization.

ZOOL 409: Principles of Circulation and Excretion 1 Cr. Hr. (L1+P 1)
Prerequisite: ZOOL 329
Haemodynamics: functional components of the circulatory system, heart structure, cardiac cycle, heart sounds, conduction system of the heart and ECG, cardiac output, blood flow, blood vessels, blood pressure and regulation. **Respiration:** structure of the respiratory system, physical aspects of ventilation, mechanics of breathing, gas exchange and transport, regulation of breathing. **Excretion:** functional organization of the kidneys, urine formation and micturition, glomerular filtration rate, renal plasma clearance, renal blood flow, renal control of electrolytes, acid-base balance, diuretics, hormonal control of urine volume and composition, renal failure and dialysis.

ZOOL 410: Principles of Developmental Biology 3Cr.Hr. (L2+P2)
Prerequisite: ZOOL 202
Stages of development, phases of ontogenic development, gametogenesis, fertilization, cleavage, blastulation, gastrulation and neurulation. Development of some organs (organogenesis) including, ectodermal derivatives (nervous system and sense organs), mesodermal derivatives (muscles, heart and urinogenital system) and endodermal derivatives (alimentary canal, liver and pancreas).

ZOOL 411: Experimental Embryology 3 Cr.Hr. (L2+P 2)
Prerequisite: ZOOL 302
Experimental study of cleavage and gastrulation, the primary embryonic induction (characteristics, chemical basis and the event of neural induction), regeneration (mechanism of regeneration, regeneration in some invertebrate and vertebrate animals and polarity in regeneration), cell culture technique (cultured cells, culture media, glassware preparation and sterilization techniques), embryonic stem cells (properties of stem cells, tests used to identify embryonic stem cells and the potential therapeutic applications of stem cells), presumptive fate maps and the principals of morphogenesis and pattern formation.

ZOOL 412: Biology of Stem Cells 2Cr.Hr. (L2+P 0)
Prerequisite: (-)
Introduction to stem cell ethics – Stem cell properties – Pluripotent – Embryonic development and differentiation – Embryonic stem cell applications – Adult stem cells - General methods and instrumentation in stem cell biology – Bone marrow stem cells – Haematopoietic stem cell biology – Signal transduction in haematopoietic development – Nervous system development and neural stem cells – Hot topics in stem cell research – Customized human embryonic stem cells – Stem cells and cancer – Treatment of cancer using adult stem cells.

ZOOL 413: Biological Clock and Cell Signalling 1 Cr.Hr. (L1+P 0)
Prerequisite: ZOOL 306
Biological clock (Chronobiology): the circadian clock in animals, sleep and wake cycle, light and the biological clock, circadian rhythm and airline pilots, melatonin and the biological clock, hypothalamic regulation of sleep and circadian rhythms, the suprachiasmatic nucleus in the brain and circadian cycle.
Cell Signalling: general principles of cell signalling, extracellular and intracellular signalling molecules, cell signalling through intracellular receptors, cell signalling through cell surface receptors, the major cell signalling pathways, cell signalling in prokaryotic cells.

ZOOL 414: Genetic Engineering 2Cr.Hr. (L2+P 0)
Prerequisite: ZOOL 305
Detailed study of recombinant DNA technology in different fields of genetic engineering , tools of genetic engineering and how can be selected: restriction enzymes, Cloning Vectors, Cloning in Prokaryotic host cells, Cloning in Eukaryotic host cells, Cloning without host cells (PCR), Genomic Libraries, cDNA Libraries, Chromosome Walking, Restriction Maps, Blotting Techniques, DNA Sequencing, Producing Transgenic Animals, Application of Transgenic Animals, tissue engineering, gene therapy.

ZOOL 415: Cancer Biology 2Cr.Hr. (L2+ P0)
Prerequisite: ZOOL 304 OR 305
An overview of the cancer development process at the cellular and molecular level, including definitions, epidemiology, nature and causes of cancer. Cancer genes control cell proliferation, apoptosis, senescence, genome integrity and cellular differentiation, Epigenetics and cancer, Invasion and metastasis, the environment and cancer, nutrition and cancer, grades of cancer, cancer of some body organs, an account on different ways of treatment.

ZOOL 416: Animal Behaviour Cr.Hr. (L1+P1)
Prerequisite: (-)
Innate types, reflexes, taxes, kinesis and instinctive behaviour – Learned types, imprinting, Pavlovian conditioning, operant conditioning, insight, reasoning and memory, group behaviour, animal aggregations and animal societies – Genetic and evolutionary behaviour, rhythmic behaviour and biological clocks.

ZOOL 417: Toxicology and Environmental Pollution 2 Cr.Hr. (L2+P0)
Prerequisite: (-)
Classification of environmental toxicants – Describe the biological effects of natural toxicants – Describe the biological effects of industrial toxicants – Outline the fundamentals of biological treatment systems, pollution control and bioremediation – Outline the fundamentals of environmental chemistry, the chemical aspects and hazardous materials in environment – Know the characteristics of atmospheric and air pollution – Describe the main concept of food and poison chemistry – Know the characteristics of biological pollution of drinking water – Describe the methods of industrial pollution control.

ZOOL 418: Parasite Epidemiology and Control 2 Cr.Hr. (L2+ P0)
Prerequisite: (-)
Disease etiology, disease surveillance, drug resistance and geographical spread and screening, biomonitoring, and comparisons of treatment effects in clinical trials for both human and

animals, the parasite epidemiology and control. The course will also cover the use of geographic information systems (Epi-GIS) for epidemiological surveillance, which is a rapidly growing area of research in infectious diseases. Molecular epidemiological approaches are also particularly encouraged.

ZOOL 419: Principles of Aquatic Ecology **2Cr.Hr. (L1+P2)**
Prerequisite: ZOOL 207
Basic knowledge of ecology, the physical and chemical aspects of aquatic systems and the life cycles and adaptations of aquatic organisms, effects of environmental factors on aquatic fauna, marine and freshwater food chains, biotic diversity, productivity, and water pollution. After completion of the course, students will be competent to apply ecological concepts to aquatic systems and to understand the impacts of human activities on aquatic ecosystems.

ZOOL 420: Research Project **1 Cr.Hr. (L1+P1)**
Prerequisite: (-)
Laboratory experience in experimental design and research in selected problems: the students are trained to deal with the scientific equipment, apply the lab ethics, and carry out practical work coherently under supervision and guidance to deal and solve a scientific problem. In addition, students are trained to analyse and interpret the obtained results, submit the results in a seminar, and write a scientific report for evaluation.

ZOOL 421: Physiology (2) **4 Cr.Hr. (L3+P3)**
Prerequisite: ZOOL 322
Nervous system and muscle contraction: neurons and glial cells, conduction of nerve impulses, the central and peripheral nervous system, EEG and brain waves, structural organization of skeletal muscles, neuromuscular junction and motor units, mechanism of skeletal, cardiac and smooth muscles' contraction. **Endocrinology and reproduction:** different endocrine glands and their hormones, mode of hormone action, ectopic sources of hormones, hormonal regulation of male and female reproductive system. **Excretion:** functional organization of the kidneys, urine formation and micturition, GFR, renal plasma clearance, renal blood flow, acid-base balance, diuretics, renal failure and dialysis.

ZOOL 422: Recent Trends in Animal Taxonomy **1 Cr.Hr. (L+ P1)**
Prerequisite: (-)
Classic and modern methodology used in animal taxonomy. Principles of taxonomy, identification and taxonomic morphology of animals. The use of different types of microscopes in identification and classification. Comparative spermatology and classification. Molecular techniques used in taxonomy like RAPD-PCR. This course will deal with drawing of evolutionary trees and how to use taxonomical keys in identification and classification of organisms.

ZOOL 423: Radiobiology **2 Cr.Hr. (L2+P0)**
Prerequisite: (-)
Radioactivity: natural and artificial sources – Scales and measurements – Nuclear radiations and particles of interest in biology – Non ionizing radiation: types, interaction, biological effect, hazards, protection and applications – Ionizing radiation: types and interaction, biological effect, hazards, protection and applications – X-ray scattering and imaging – Nuclear isotopes – Dosimeters and detectors.

ZOOL 424: Principles of Comparative Anatomy **2 Cr.Hr. (L2+ P1)**

Prerequisite: ZOOL 212

Major aspects of the comparative anatomy focuses on vertebrate design, function and diversification and deals with the exoskeleton, endoskeleton, urinogenital system and cardiovascular system of some representative vertebrate animals of the major groups of vertebrates, and their functional and evolutionary relationships, differentiations of the integument, axial and appendicular system (neurocranium, splanchnocranium, formation of limbs, types of vertebrae), evolution of the heart and the major vessels, osmoregulation, evolution of the renal system, formation and structure of the gonads, orgasm, ect.

ZOOL 425: Teratology **2 Cr.Hr. (L2+P0)**

Prerequisite: ZOOL 302

Principles of teratology, congenital malformations, factors that cause abnormalities, mechanisms and patterns of abnormal embryonic development, teratogenic agents, types of abnormalities, limb anomalies, vertebral column defects, neural tube defects, cardiac malformations, respiratory system defects, digestive systems defects, urinogenital anomalies, cleft lip and cleft palate, congenital malformations of eye and ear.

ZOOL 427: Genomics & Proteomics **2Cr.Hr. (L2+P 0)**

Prerequisite: ZOOL 304 Or 305

Structure and function of genome with emphasis on genome mapping and sequencing projects, Sequence similarities, Sequence alignment, Physical mapping, Phylogenetic analysis. Primer design, Microarray analysis and experimental bioinformatics tools associated with gene expression. The topics of Proteomics include: Analysis of proteomic data, 3D protein structure, Homology modeling and protein expression mapping, Experimental and bioinformatics tool associated with protein expression maps, Protein mass spectrometry.

ZOOL428 : Hypersensitivity and Autoimmune Diseases **2Cr.Hr. (L2+ P0)**

Prerequisite: ZOOL 322

How IgE produces in response to allergens, effector mechanisms involved in allergic reactions, immunological and non-immunological degranulation of mast cells, types of hypersensitivity reactions, mechanisms that maintain autotolerance, the aetiology of autoimmune diseases, laboratory diagnosis of autoimmune diseases, extrinsic regulation of unwanted immune responses.

ZOOL 429: Selective Topics **2 Cr.Hr. (L2+ P0)**

Prerequisite: (-)

This course explores the current advances and progress in the field of **Physiology** in its broadest sense. The topic and contents will be announced periodically each time the course is presented. The course objective is to provide the novel information in one or more of the particular areas that may be of interest to the students to expand their knowledge.

ZOOL 430: Introduction to Protozoology **2Cr.Hr. (L1+P2)**

Prerequisite: ZOOL 102

Classification of the Protozoa including recent theories, ecology of protozoa, morphology and structure of protozoan cell, different biological activities of protozoa as (locomotion, respiration, nutrition, excretion, reproduction and osmoregulation), supportive structure, life cycle patterns of the main protozoan groups and their biological and economic importance.

ZOOL 432: Selective Topics **2 Cr.Hr. (L2+ P0)**

Prerequisite: (-)

This course explores the current advances and progress in the field of **Cell Biology and Histology** in its broadest sense. The topic and contents will be announced periodically each time the course is presented. The course objective is to provide novel information in one or more of the particular areas that may be of interest to the students to expand their knowledge.

ZOOL 434: Animal Biology **1 Cr. Hr. (L1+P0)**

Prerequisite: (-)

General concepts of animal nutrition and food stuff (carbohydrates, proteins, fats, vitamins and minerals), digestion, metabolism (anabolism and catabolism), animal transport system, gas exchange in animals, urinary system and excretion, defence against infectious diseases and cancer, neurobiology and muscles action, animal hormones and chemical regulation.

Course Contents of the Entomology Department

ENTM 401 Advanced Insect Physiology **5Cr.Hr. (L3+P4)**

Prerequisite: ENTM 203

1. The physiology of the main systems involved in the survival, growth and reproduction of insects will be considered including the muscular, nervous and endocrine systems.
2. Peculiarities of the studied systems and their physiological roles will be analyzed and compared in the diverse groups of insects.

ENTM 402 Insect Toxicology and Resistance **5Cr.Hr. (L3+P4)**

Prerequisite: ENTM 202

1- Introduction

2- Classification of insecticides (inorganic insecticides- organic insecticides

3- Resistance to insecticides

4- Genetic principles of resistance

5- fade of insecticides in environment (residual analysis)

6- Economic and legal aspects of insecticides use-

ENTM 403 Molecular Entomology and Genetic Engineering **3Cr.Hr. (L2+P3)**

Prerequisite: ENTM 304

1. The nature of the gene, the genome sequencing and mapping.
2. Utilization of Genetic Information; From Transcription to Translation.
3. The Cell Nucleus and the control of gene expression.
4. DNA replication and repair.
5. Genetic manipulation of insect genome.
6. Gene cloning and expression profiling.
7. Analysis of cloned genes.

ENTM 404 Integrated Pest Management **2 Cr.Hr. (L2+P0)**

Prerequisite: ENTM 202

1. Pest management concepts and economic threshold.
2. IPM programs.
3. Construction of an intact framework strategy for IPM.
4. Monitoring and evaluation of IPM programs.

ENTM 405 Advanced Insect Behaviour **1Cr.Hr. (L1+P0)**

Prerequisite: ENTM 303 or (-)

1. Introduction.
2. Some fundamentals of behaviour: a. Sensory reception: mechano-, chemo-, hygro-, thermo- and photo-reception.

b. Basic responses and patterns of behavior: innate behaviour - learned behavior .
c. Behavioral periodicity .
d. Displacement - orientation - communication - host selection and feeding – nest building-behaviour defense - parental care and social behaviour.

3. Genetic principles of behaviour. 4. Communication between Insects.

ENTM 406 Advanced Population Dynamics **1 Cr.Hr. (L1+P0)**

Prerequisite: ENTM 301 or (-)

1. Introduction to population dynamics.
2. Dynamic characteristics of population:
   a- Population density. b- Natality. c- Mortality.
   d- Growth rate. e- Age distribution. f- Biotic potential.
   g- Dispersion and dispersal.

ENTM 408 Essay **2Cr.Hr. (L2+P0)**

Prerequisite: (-)

Throughout both terms, each student writes an essay on a selected subject under the supervision of one of the staff members. The student presents a written dissertation, and summarizes his work in a talk held at the Department held at the end of the academic Year.

ENTM 409Safe Use of Pesticides **2Cr.Hr. (L2+P0)**

Prerequisite: (-)

1- Reading pesticide container label: labelinformation,pesticidelicensing,the label and the law,caution and danger signals,instructions in case of emergency.
2- International arrangements and personal precautions related to the safe use and application of pesticides.
   Precautions to be strictly observed for pesticide application: a) Before applying pesticides b) While mixing pesticides and during application. c) After insecticide application: d) Disposal of Pesticides. e) Safe storage of Pesticides f) Dealing with Spills
3- First aid measures in case of accidental poisoning

ENTM 410 Planning Pest management Programs **1 Cr.Hr. (L1+P0)**

Prerequisite: ENTM 202or (-)

1. Introduction:
2. Definitions and terminology.
3. What is a management program?
4. When does a pest reach an economic level to resolve to a management program?
5. Applying the scientific method in planning pest management programs.
6. Case study: Example of a successful pest management program built on scientific basis.
7. Pre-application phase-Application phase-Post application phase

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ENTM 411 Insect Immunity **1 Cr.Hr. (L1+P0)**

Prerequisite: (-)

1. Cellular defense responses in insects.

2. Main events in insect immune reactivity.
3. The response of foreign tissue transplants in insects.
4. Graft rejection in insects.
5. Insect immune proteins.

ENTM412 Conservation biology **1 Cr.Hr. (L1+P0)**

Prerequisite: (-)

1. Introduction and historical.
2. Insects and biodiversity: Threats to Biological Diversity.
3. Conservation status. 4- The Red List of endangered species.
5- Risk categories. 6- Causes of endangerment: 7- Natural causes.
8- Human activities. 9- Nature and protection of biodiversity: Insect response to change.
10- Man and protection of biodiversity. 11- Conservation, Preservation and Restoration.
4- Conservation strategies: Researching - Protected areas - Wildlife corridors.

ENTM 413 Population Genetics **1 Cr.Hr. (L1+P0)**

Prerequisite: (-)

1. General principle
   Formal objective of population genetic, genetic variability in population, mutation as a source of genetic variability, Estimation of genetic variability in a population.
2. Mandelian population
3. Evolutionary agents (Fitness, selection, migration, random drift in small population).
4. Speciation and Molecular evolution

ENTM 414 Numerical Taxonomy **2Cr.Hr. (L2+P0)**

Prerequisite: (-)

1. Phenetic Taxonomy (Phenetic method).
2. Cladistic Taxonomy (cladistic method).
3. Problems and advantages of Numerical Taxonomy.

ENTM 416 Glands and Secretions in Insects **1 Cr.Hr. (L1+P0)**

Prerequisite: (-)

Structure and function of:

1. Exocrine glands
   Epidermal glands – wax glands – head glands
   "Mandibalar, pharyngeal, maxillary and labial glands"
   Trophallaxis – silk production – defensive glands
   Pheromone producing glands
2. Endocrine system and neurohormes: Neurosecretory system – Moulting glands and moulting hormone – Carparaallata and juvenile hormone.

ENTM 418 Biotechnology **1 Cr.Hr. (L1+P0)**

Prerequisite: (-)

1. Advent of the Biotechnology Revolution
2. Packaging of nucleic acids
3. Bacteria as the workhorses of biotechnology
4. Basic Genetics of eukaryotic cells

5. Multicellular organisms including insects as research models.

ENTM 419 Insect Molecular Biology and Genetic Engineering3Cr.Hr. (L2+P2)
Prerequisite: ENTM 320

1. Genes, Genomics, and Chromosomes.
2. The Central Dogma: DNA as Chemical and Genetic Material
3. Synthesis and properties of RNA and proteins.
4. DNA Repair and Recombination.
5. How to clone a gene - What is clone, Overview of the procedure, Gene library, and hybridization
6. Extraction and Purification of nucleic acids,
7. Detection and Quantitation of Nucleic acids. 8. The Future of Molecular Biology.

ENTM 420 Pesticide Toxicology and Resistance 5Cr.Hr. (L3+P4)
Prerequisite: ENTM 320 or ENTM 202

1. Definition of toxicology. 2. History and evolution.
3. Insecticide groups: (Inorganic insecticides - Natural botanical - Chlorinated hydrocarbons - Organic phosphates - Carbamates - Pyrethroids).
4. Insect resistance: a- Cross Resistance b- Vigor tolerance c- Modes of resistance. d- Countermeasures for resistance.
5. Genetic principles of resistance.
6. Residue analysis. 7. Legal aspects of insecticide use.

ENTM 421 Fundamental of Insect Physiology 5Cr.Hr. (L3+P4)
Prerequisite: ENTM 254

Provide basic knowledge of insect physiology - Function and main physiological processes of the different systems such as molting and metamorphosis, digestion, hemolymph circulation, excretion, respiration and reproduction will be studied.

ENTM 422 Concepts of Integrated Control 1Cr.Hr. (L1+P0)
Prerequisite: ENTM 202

1. Conceptions of IPM.
2. IPM programs.
3. Strategy, Monitoring and evaluation.

ENTM424 Principles of Numerical Taxonomy 2Cr.Hr. (L2+P0)
Prerequisite: (-)

1. Introduction to Numerical Taxonomy.
2. The procedure of Numerical Taxonomy.
3. Methods of phylogenetic analysis and evolutionary relationships.

ENTM 430 Principles of Biotechnology 1Cr.Hr. (L1+P0)
Prerequisite: (-)

1. History and methodology of insect gene transfer.
2. Gene targeting.
3. Transgenic selection.
4. Develop genetically modified insects (GM) for a wide variety of purposes.
5. Transgenic insect fitness.
6. Regulation of transgenic arthropods and other invertebrates including insects.