Course Contents of Chemistry Department

CHEM 301: *Analytical Chemistry* **2 Cr.Hr. (L1+P 3)**

Prerequisite : CHEM 101 and 102

Part 1: Optical Methods of Analysis: General features of analytical instruments, their performance characteristics, and calibration methods. The components of optical instruments, in terms of electronics and optical components, and the concept of signal to noise. Various molecular spectrometric methods are covered including: UV-Vis spectrometry, molecular fluorescence, molecular phosphorescence, chemi-, and bioluminescence. Bases of atomic spectrometric methods including different techniques of atomic absorption and emission, as well as atomic fluorescence and their analytical applications. Basics of X-ray methods of analysis and mass spectrometry.

Part 2: Chromatography: Principles of chromatography: chromatographic parameters, efficiency, optimization, and Van Deemter equation. Rigorous details of theory, instrumentation and applications of gas and liquid chromatography, as well as high performance liquid chromatography. Various types of liquid chromatography including. Introduction to contemporary separation methods such as supercritical fluid chromatography/extraction, electrophoresis, capillary electrophoresis, and hyphenated techniques such as HPLC-MS, and GC-MS.

Practical: Hands-on experience in applying electrochemical methods to the analysis of different real samples such as food, soil, drinking and raw water samples. basis of separation science by running simple chromatographic experiments such as TLC and ion-exchange chromatography.

CHEM 303: *Physical Chemistry (Chemistry of Cement)* **3 Cr.Hr. (L2+3)**

Prerequisite: CHEM 102

Nomenclature, types of cements (Portland and non-Portland cements), the mechanism of cementing action (reactivates of anhydrous compounds, products formed on hydration, theories of setting and hardening). Hydration of Portland cement: hydration of pure cement components (calcium silicates, tri-calcium aluminates and ferrite), factors affecting the rate of hydration, mechanism of Portland cement hydration. Cements made from blast-furnace slag: composition and processing of blast-furnace slag, lime-slag cement, Portland blast-furnace slag cement, kinetics and mechanism of hydration of slag cement, super-sulfate cement.

Practical: Related to the above topics.

CHEM 310: *Organic chemistry (Chemistry of Insecticides)* **3Cr.Hr.(L2+P 3)**

Prerequiste: CHEM 102

Introduction - methods of pest control - classification of pesticides - choosing the proper pest - control chemicals relation between structure and toxicity of organic insecticides - synthesis and properties of DDT and its related compounds - synthesis and properties of organic sulfur , nitrogen and phosphorus insecticides – fumigants.

Practical: Synthesis of some organic insecticides.

CHEM 311: *Organic chemistry (Heterocyclic Compounds)* **2 Cr. Hr. (L2 + P0)**

Prerequisite: CHEM 211

Systematic nomenclature of heterocyclic compounds containing one hetero atom (pyrrole, furan, thiophene, indole, quinoline, isoquinoline, coumarin,chromone) and their derivatives, di-hetero atoms and tri-hetero atoms. General preparation of hetero cyclic compounds (mono hetero atom) and its benzo-derivatives. Preparation of mono heterocycles contains more than one hetero atom and their reactions. Applications of heterocyclic compounds in pharmaceutical

drugs.

CHEM 312: ***Physico-Organic Chemistry (1)*** **2 Cr.Hr. (L2+P 0)**

Prerequisite: (CHEM 211& CHEM 212)

Introduction (types of reactions and reagents). Addition reactions to carbon-carbon multibonds. Addition to carbon heteroatom multibonds. Electrophilic aromatic substitution reactions and nucleophilic aromatic substitution reactions. Base induced elimination reactions. Acid induced elimination reaction. Rearrangement to electron deficient carbon, nitrogen and oxygen.

CHEM 313: ***Polymers and Free Radicals*** **1 Cr. Hr. (L1 + P0)**

Prerequisite: (CHEM 211)

Part 1: Polymers: Classification, -bonding and stereoisomerism of polymer chains - crystallinity in polymers - Characterization of molecular weight and methods of determination polymer solubility and solutions - Transition in Polymers - The glass transition - Polymer synthesis – functionality - Polycondensation reactions (mechanism and kinetics) - cationic and Anionic Poly- merization (meachanism and kinetics - copolymerization.

Part 2: Free Radicals: Method of production of radicals, radical substitution & addition reactions. Thermal cracking, hemolysis of peroxides, photolysis, hydrogen and halogen abstraction, configuration of free radicalas, cyclization and elimination reactions.

CHEM 314: ***Organic chemistry (Spectroscopy)*** **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 212

Principles of electronic infrared radiation (IR) [definitions, factors affecting the frequancy of functional group,....etc]- nuclear magnetic resonance (^{1}HNMR and ^{13}CNMR) and mass spectroscopy (MS)– 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

CHEM 315: ***Practical Organic Chemistry (3)*** **1Cr.Hr (L0 + P3)**

Prerequisite: (-)

Safety in the laboratory (defining the signs on bottles such as flammable, toxic, irritant ... etc), environmentally responsible handling of chemicals and solvents, crystallization (technique of crystallization and conditions for choosing the siutable solvent of crystallization), distillation, chromatographic methods extraction, determination by spectroscopic methods, drying and purifying solvents.

CHEM 316: ***Practical Organic Chemistry (4)*** **1Cr.Hr (L0 + P3)**

Prerequisite: (-)

Separation and identification of a binary mixture of organic component. Types of binary mixture, Acid-Base, Acid-phenol, Base-Phenol, Acid-Neutral, Base-Neutral, Phenol-Neutral, Neutral-Neutral. Methods of separation using different solvents such as water, dilute hydrochloric acid solution, sodium hydroxide solution, sodium carbonate.....etc.

CHEM 317: ***Organic chemistry*** **2Cr. Hr. (L2 + P0)**

Prerequisite: (CHEM 211 & CHEM 214)

Part 1: Organometallic Compounds: Preparation of organometallic compounds & their reactions of Li, Mg,Cd,Sn,P,Si,and S metal & non metals

Part 2: Stereochemistry 2: stereochemistry of biphenyl compounds - absolute configuration of biphenyl - stereochemistry of allenes - Geometrical isomerism: nature and nomenclature of geometrical isomers - Determination of the configuration - stereoselective addition and elimination reaction- Interconversion of geometrical isomers.

CHEM 319: *Organic chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 211

Part 1: Photochemistry: Energy is quantized, types of excitation, Selection rules, the fate of the excited molecule, physical process, chemical process. -Intramolecular reactions of olefin bonds: Geometrical isomerisation, cyclization reaction. -Intramolecular reactions of the carbonyl group: Saturated acyclic and side chain carbonyl compounds, saturated cyclic carbonyl compounds, β, γ- unsaturated carbonyl compounds, α, β- unsaturated carbonyl compounds, cyclohexadienones.

-Intermolecular cycloaddition reactions:

Part 2: Lipids: Introduction, simple lipids, acids and fats, chemical properties of fatty acids, isomerisation, separation and determination of fatty acids, synthesis of glycerides, physical properties of fats and oils, chemical properties of fats and oils, rancidity of edible fats, analysis of fats and oils, drying oils, compounds lipids, waxes, fats, oils, waxes & phospholipids, fatty acids, soaps and detergents, fats and oils ,waxes, phospholipids.

CHEM 321: *Inorganic Chemistry 2* **2 Cr. Hr. (L2 + P0)**

Prerequisite: CHEM 222

Coordination Chemistry (Theories and Bonding)& Chemistry of Transition Metals (d- and f- blocks)

Valence bond and crystal field theories. Tetragonal distortion and Jahn-Teller effect. Ligand field theory and π-bonding concept. Classification of ligands. Nomenclature of complexes. Stereochemistry and stereoisomerism. Magnetic properties of complexes. Electronic properties of TM ions. Chemistry of periods 3,4 and 5 d-block elements.Introduction to the chemistry of lanthanidesand actinides.

CHEM 322: *Inorganic chemistry 3(Inorganic Reaction Mechanisms)* **2 Cr.Hr. (L1 + P 3)**

Prerequisite: CHEM 321

Introduction to inorganic reaction mechanisms. Substitution reactions for octahedral and square planar complexes. Oxidation-reduction reactions for complexes. Oxidative-addition and reductive-elimination reactions. Insertion reactions. Hydrogen elimination reactions. Homogeneous catalytic processes (hydrogenation reactions, hydroformylation reactions and Wacker process).

Practical: Synthesis of some metal complexes and determination of their structures.

CHEM 324: *Inorganic Chemistry 4* **2 Cr. Hr. (L2+P 0)**

Prerequisite: CHEM 321

Bioinorganic Chemistry& Inorganic Polymers:

Coordination chemistry and bioinorganic chemistry. Coenzyme B12. Hemoglobin and myglobin. Chemotherapy, principles and applications. Definition of inorganic polymers. Silicones, siloxanes, silanes, silicon carbide and silicon nitride. Organoboron polymers. Alumoxanes polymers. Sulphur-nitrogen polymers. Sol-gel Synthesis. Synthesis of nanocomposite materials via inorganic polymer gels.

CHEM 331: *Analytical Chemistry 2 (Spectrochemical methods of analysis 1)* **2Cr. Hr. (L2+P0)**

Prerequisite: Chem231

Fundamentals of absorption and emission spectrophotometry; applications of UV-Vis, fluorescence, phosphorescence, chemi-luminescence and bio-luminescence, spectrophotometry; spectrophotometric instrumentation; atomic absorption and emission

spectroscopy, atomization, instrumentation, interferences and ICP. This course also deals with applications of spectrochemical techniques to real samples.

CHEM 333: ***Practical Analytical Chemistry 2*** **1Cr. Hr. (L0 + P3):**

Prerequisite CHEM 231

This course aims at introducing students to analytical instrumentation and in particular optical instruments. Students will gain hands on experience on using various optical instruments such as single beam and double beam spectrometers as well as fluorimeters and atomic spectrometers. Students will be trained to utilized such instruments in analysis on anions, cations using direct calibrations, standard additions as well as photometric titrations. Students will be also trained to handle real samples.

CHEM 335: ***Analytical chemistry 3*** **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 231

Part 1: Environmental analysis: Environmental Data Acquisition, Basics of Environmental Sampling and Analysis, Environmental Sampling Design & techniques, Methodology and Quality Assurance/Quality Control of Environmental Analysis, Common Operations and Wet Chemical Methods in Environmental Laboratories, Fundamentals of Sample Preparation for Environmental Analysis,

Part 2: Green analytical chemistry: The Concept of Green Analytical Chemistry; Green Analytical Laboratory Experiments; Greening Sampling Techniques; Green Analytical Chemistry Approaches in Sample Preparation; Green Analytical Spectrometry; Solid Phase Molecular Spectroscopy; Energy Savings in Analytical; Miniaturization; Photocatalytic Treatment of Laboratory Wastes Containing Hazardous Organic; Green Bioanalytical Chemistry; Green Industrial Analysis

CHEM 338: ***Analytical Chemistry E*** **2 Cr.Hr (2+0)**

Prerequisite: CHEM 231

Atomic emission spectrometry, Atomic mass spectrometry, Atomic X-ray spectrometry, Raman spectroscopy, Mass spectrometry, Surface characterization by spectroscopy & microscopy, Particle-size determination; Basics and applications of hyphenated instrumental techniques in analytical laboratories. Flow injection methods analysis and automation in analytical chemistry

CHEM 341: Physical Chemistry (4) **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 242

Part 1: Surface Chemistry [2]: Gas-solid and solution-solid interface: Sorption–adsorption of gases, factors influencing forces and the energy of adsorption, physisorption and chemisorption , potential energy in relation to surface structure, monolayer capacity – extent, heats, theories and multimolecular theory of adsorption (BET), determination of the specific surface area by applying the BET equation, desorption, surface area in the pores structure, thickness of the adsorbed layer in the capillary condensation region, adsorption from solution, mechanisms of adsorption, adsorption isotherms, pore size determination, determination of acidic properties on solid surfaces, acid strength, acid amount.

Part 2: Catalysis: 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, and the roles of surface area and pore structure on them, chemisorption in catalysis: theories and types, kinetics and mechanism of heterogeneous catalytic reactions, models of active centers, some applications in industry.

CHEM 342: *Physical Chemistry (5)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 241

Part 1: Thermodynamics of electrolytic solutions (Electrochemistry): Electrolytic solutions and electrical double layer, electrolytic solutions, electrical conductance, Arrhanuis theory for electrolytic dissociation, migration of ions, mobility of ions, transport number, deviation of electrolytic solutions from ideal solutions, Van't Hoff factor, solvation, activity and activity coefficient, partial molar quantities, Debye and Huckel's theory for strong electrolytes, ionic association theory. Models of electrical double layer. Capacity of electrical double layer.

Part 2: Photochemistry: Introduction: 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. Laws of absorption, 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, oxyge and heavy atom quenching, kinetics of quenching, charge transfer and electron transfer, flash photolysis, laser.

CHEM 343: *Practical Physical Chemistry (2)* **1 Cr.Hr. (L0+P 3)**

Prerequisite: CHEM 243

Practical chemistry experiments of Chemical kinetics and Phase equilibria

CHEM 344: *Practical Physical Chemistry (3)* **1 Cr.Hr. (L0+P 3)**

Prerequisite: (CHEM 243 & CHEM 341)

Practical chemistry experiments of surface chemistry and catalysis

CHEM 345: *Physical Chemistry B (Colloids)* **1 Cr.Hr. (L1+P 0)**

Prerequisite: CHEM 242

Classification of colloidal systems, colloidal dispersions, sols, preparation, purification and properties of sols, coagulation of sols, stability of sols, protection of sols, associated colloids (micelles), preparation and properties of emulsions, edible emulsions, gels (classification and properties), aerosols (classification and properties), macromolecules, colloidal systems in our life (applications).

CHEM 346: *Physical Chemistry (C)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 341

Part 1: 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.

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

CHEM 347: *Industrial Electrochemistry* **1 Cr.Hr. (L1+P 0)**

Prerequisite: CHEM 241

Introduction: electrolysis, special features of electrochemical processes, electrochemical reactors, classical cell design, the space time yield, morphology of electrocatalysis and

activation polarization. The Chlor-Alkali industry: reactions, the diaphragm cell, mercury cell, membrane cell. Electrochemical extraction and purification of metals. Electrowining of metals (Zinc). Molten salt electrolysis, extraction of Al metal purification in aqueous solution (Cu). Electrochemical preparation of inorganic chemicals. Anodic production of gases: oxygen, chlorine and fluorine. Water electrolysis, electrochemical treatment of wastewater. Direct and indirect electrochemical oxidation and electrodialysis. Electro-organic synthesis: specific features, synthesis of adiponitrile- Monsanto process. Electrodeposition and metal finishing: electrodeposition of metals, electroplating and metal processing. Anodizing of active metals (Al). Batteries and fuel cells: primary cells, secondary cells and fuel cells (Bacon's oxygen/hydrogen fuel cell.

CHEM 351: *Heterocyclic Compounds* **3 Cr. Hr. (L2 + P3)**

Prerequisite: CHEM 205

Systematic nomenclature of heterocyclic compounds containing one hetero atom (pyrrole, furan, thiophene, indole, quinoline, isoquinoline, coumarin,chromone) and their derivatives, di-hetero atoms and tri-hetero atoms. General preparation of hetero cyclic compounds (mono hetero atom) and its benzo-derivatives. Preparation of mono heterocycles contains more than one hetero atom and their reactions. Applications of heterocyclic compounds in pharmaceutical drugs.

Practical: Related to the above topics.

CHEM 353: *Organic Chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite CHEM 102

Part 1: Dyes: Nomenclature, classification -systematic study of different classes of dyes. e.g. nitro- nitroso azo, diarylmethane , triarylmethane, xanthene, acridine, quinoline ,azines, vat and anthraquinonoid dye,

Part 2: Polymers: Classification, -bonding in polymers- Stereoisomerism of polymer chains - crystallinity in polymers - Characterization of molecular weight and methods of determination polymer solubility and solutions - Transition in Polymers - The glass transition - Polymer synthesis - functionality - Polycondensation reactions (mechanism and kinetics) - cationic and Anionic Polymerization (mechanism and kinetics) - copolymerization.

CHEM 360: *Organic chemistry* **3 Cr.Hr. (L2+P 3)**

Prerequisite: CHEM 260

Part 1: Dyes: Nomenclature, classification -systematic study of different classes of dyes. e.g. nitro- nitroso azo, diarylmethane , triarylmethane, xanthene, acridine, quinoline ,azines, vat and anthraquinonoid dye,

Part 2: Organic Spectroscopy: Principles of electronic- infrared - nuclear magnetic resonance and mass spectroscopy – relation between molecular structure of organic compounds and electronic, IR, ^{1}HNMR.

Practical: related to the above topics

CHEM 361: *Organic chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite CHEM 261

Part 1: Stereochemistry: Optical isomerism- conformational analysis - conventions used in stereochemistry correlation of configuration and specification of absolute configuration-elements of symmetry and molecular asymmetry - the number of isomers in optically active compounds- the racemic modification (synthesis, properties, resolution) -epimerisation-mutarotation- absolute and relative configurations (R and S) - asymmetric synthesis - Walden inversion- conformations and conformational analysis.

Part 2: Carbohydrates: Introduction, nomenclature. Monosaccharides (determination of the configuration. ring structure, mutarotation, methods for determining the size of the sugar rings.

Disaccharides (sucrose, maltose, etc)- structure and reactions. Polysaccharides (starch, cellulose, etc…) structure and reactions: structure of amylase - end group analysis-structure of amylopectin.

CHEM 362: *Organic chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 260

Part 1:Vitamines: Definition- structure elucidation by using spectroscopy, chemical methods and synthesis of vitamin B complex group as water soluble: Vitamin B1 (Thiamine), vitamin B2 (Riboflavin). Pantothenic acid, folic acid (peroylglutamic acid), biotins (vitamin H), vitamin B6 (pyridoxine), vitamin B12 (cyanocobalamin), nicotinic acid and nicotinamide - Vitamin E group: Tocopherols - vitamin K1 and vitamin K2.

Part 2: Chemotherapy: Introduction, sulphonamides (sulphapyridine, sulphathiazole, etc) antimalarials e.g (plasmoquine, mepacrine), arsenical drugs e.g (arsphenamine, atoxyl), anytibiotics e.g (penecilline chloramphenicol ,streptomycin , etc....)

Pratical : Preparation of some organic compounds.

CHEM 363: *Organic Chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite CHEM 261

Part 1: Amino Acids and Proteins: Classification- methods of preparation (Gabriel`s, strecker, malonic ester, curtius, azlactone etc) - analysis of amino -acids protein hydrolisates, reactions. Protein; classification, synthesis of peptides, peptide linkage, C-terminal and N-terminal amino-acid determinations, partial hydrolysis of peptides, , spatial arrangement of protein molecules.

Part 2: Anthocyanins: General structure and synthesis of: flavones - Isoflavones – flaronol – quercetin - biosynthesis of flavonoids , pelargonidin chloride, cyaniding chloride, delphinidin chloride, peonidin chloride, malvidin chloride.

CHEM 370: *Inorganic chemistry (Organometallics)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 271

General properties of organometallic complexes. The EAN rule. Organometallic compounds of main group elements. Comparison between classic and non-classic complexes, 18-electron rule, studies of different types of complexes of π-acid ligands metal carbonyls (binary, hydrides and halides) and phosphine and other π-complexes, types of bonding, preparation and characterization. The chemistry of metal alkyls, aryls, alkenes and alkynes

CHEM 371: *Inorganic Chemistry* **2Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 271

Coordination Chemistry (Theories and Bonding)&Chemistry of Transition Metals (d- and f- blocks)

Valence bond theory (VBT), crystal field theory (CFT), ligand field theory (LFT), molecular orbital theory (MOT), comparison between them and their applications to coordination compounds. Basic features of transition metals, their compounds including organometallic ones, systematic study of the chemistry of the elements and their applications.

CHEM 380: *Analytical chemistry Instrumental analysis (Optical Methods)* **3Cr.Hr. (L2+P 3)**

Prerequisite: CHEM 281

General features of analytical instruments, their performance characteristics, and calibration methods. The components of optical instruments, in terms of electronics and optical

components, and the concept of signal to noise. Various molecular spectrometric methods are covered including: UV-Vis spectrometry, molecular fluorescence, molecular phosphorescence, chemi-, and bioluminescence. Bases of atomic spectrometric methods including different techniques of atomic absorption and emission, as well as atomic fluorescence and their analytical applications. Basics of X-ray methods of analysis and mass spectrometry.
Practical: Hands-on experience in applying molecular spectroscopic methods to the analysis of different real samples and applying spectrophotometry in fundamental chemistry applications such as calculations of the metal-ligand binding constants and stoichiometry.

CHEM 381: ***Green Chemistry*** **1 Cr. Hr. (L1+P0)**
Prerequisite: (CHEM 281)
This course will focus on hazards to health and the environment that makes green chemistry's most daunting challenges, and will develop the skills necessary for articulating the causes and consequences of pollution. This course will also cover principles and basic concepts of green chemistry; water: production, problems & prevention; catalysis and green chemistry; organic solvents: environmentally benign solutions; renewable resources; designing greener processes with industrial case studies.

CHEM 383: ***Applied inorganic Chemistry*** **2 Cr.Hr. (L2+P 0)**
Prerequisite: CHEM 271
Polymers on the basis of S; P; Ge; Se; Si etc.; Adhesives; Silane Coupling Agents; Silicones and silicon rubbers; Polymer composites; Fillers; Clays and Asbestos. Glass and ceramic industries, dyes and pigments.

CHEM 390: ***Biophysical Chemistry*** **2 Cr.Hr. (L1+P 3)**
Prerequisite: (CHEM 290)
Organization, Biological macromolecules and the forces that stabilize them, Entropy and dynamics in biomolecules, dynamic light scattering, thermodynamics of biomolecules (ITC, DSC), Levinthal's paradox: folding conundrum, Quantum mechanics – interaction of electromagnetic radiation with matter, Transition dipole moments, Einstein coefficients, Molecular absorption spectroscopy, peptides and nucleic acids, Linear and circular dichroism, Luminescence spectroscopy (fluorescence, phosphorescence), FRET, FRAP, Time-resolved fluorescence, single-molecule experiments, AFM, Cooperativity and allostery: classic and modern views, Introduction to magnetic resonance, EPR & NMR, Solid-state NMR (SSNMR) spectroscopy, Chemical exchange and biomolecular dynamics Conformational entropy in recognition, rational drug design, Macromolecular structure determination by hybrid approaches.
Practical: Some biophysical chemistry experiments.

CHEM 391: ***Physical chemistry*** **3 Cr.Hr. (L3+P 0)**
Prerequisite: (CHEM 290 & CHEM 292)
Part 1: Surface Chemistry (1): Surface tension and surface free energy, contact angle, the equation of Young and Laplace and its experimental verification, Dupre's equation, spreading of a liquid on a substrate, phenomenon at curved interfaces (Kelvin equation), adsorption and orientation at interfaces, surface activity and Traub`s rule, thermodynamic of adsorption, Gibb`s adsorption equation (dilute solutions), Szyskowski equation (concentrated solution), surfactants: classification, properties, , liquid-liquid interface, , solid-gas and solid-liquid interfaces.
Part 2: Catalysis: Introduction: Criteria of catalysis, homogeneous catalysis, the intermediate compound formation theory, catalytic decomposition of hydrogen peroxide, acid base,

enzymatic and 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.

Part 3: Physical Properties of Polymers: Introduction to polymer Science: Polymer science: classification of polymers – synthesis of polymers – physical states transitions and degradation, Glossary and chemical formulas of a series of polymers. Macrogalleria. Specific features of polymers. Types of Interaction. Chain flexibility. Thermomechanical curves of polymers. Mechanisms of polymerization and polycondensation. Regular and Irregular polymers. Additives. Molecular Weight Determination. Mechanical Properties of Polymers. Polymer Processing. Polymer Testing. Polymers for hightech.

CHEM 393: ***Physical chemistry (Electrochemistry 2)*** **1 Cr.Hr. (L1+P 0)**

Prerequisite: CHEM 290

(Kinetics of electrochemical reactions/Irreversible electrode processes): Polarization and overpotential, Measurement of polarization, Causes and types of polarization, Resistance polarization, Concentration polarization and oxygen reduction reaction, theories of rotating disc electrode, rotating ring electrode & their applications Activation (charge transfer) polarization, Butler – Volmer eqation, Tafel Equation. Real polarization Curve (I-E voltammogram), Methods of determining the current-overpotential curves (Tafel plots) and cathodic hydrogen evolution reaction.

(Applied chemistry students)

APCH 311:*Applied organic chemistry 1* **3 Cr.Hr. (L3+P 0)**

Prerequisite: CHEM 211

Part 1: Carbohydrates: Introduction, nomenclature. Monosaccharide (determination of the configuration, ring structure, mutarotation, methods for determining the size of the sugar rings. Disaccharides andpolysaccharides -structure and reactions. Structure of amylase - End group analysis - structure of amylopectin.

Part 2:Fats: Introduction of simple lipids, separation of fatty acids, preparation of glycerides, chemical and physical prosperities, different methods for extraction from natural sources, methods of analysis and purification of fats and oil, such as phospholipids, glycolipides and waxes.

Part 3: Stereochemistry: Optical isomerism - elements of symmetry and molecular asymmetry- the racemic modification- conventions used in stereochemistry correlation of configurations - specification of absolute configuration- epimerisation- mutarotation - asymmetric synthesis - the Walden inversion- conformational analysis –geometrical isomerism.

Part 4: Chemotherapy: Introduction,sulphonamidese.g (sulphanilamide, sulphapyridine, sulphathiazole) antimalarialse.g (plasmoquine , mepacrine), arsenical drugs e.g (arsphenamine , atoxyl), anytibioticse.g(penecilline ,streptomycin).

APCH 312:*Applied organic Chemistry 2 (Spectroscopy and Dyes)* **2 Cr.Hr. (L2+P0)**

Prerequisite: CHEM 211

Part I:Spectroscopy: Principles and application of electronic- Infrared, NMR(H^1 and C^{13}), and mass spectroscopy-relation between, molecular structure of organic compounds and their spectroscopic properties.

Part II:Dyes: Nomenclature- classification and systematic study of some classes of dyes.

APCH 313:*Practical Applied Organic Chemistry 1* **1 Cr.Hr.(L0 + P3)**

Prerequisite: (-)

General methods of Isolation, Separation and Purification. Techniques and methodologies for the isolation, characterization and quantitation of natural products (such as terpenes, steroids , carbohydrates and alkaloids) by using solvent with different polarity. The isolation and purification techniques including extraction, recrystallization, melting and boiling points, distillation, sublimation and precipitation. Chromatographic methods based on their prior knowledge from analytical Chemistry (by using thin layer chromatography).

APCH 314:*Practical Applied Organic Chemistry 2* **1 Cr.Hr.(L0 + P3)**

Prerequisite:CHEM 211

Liquid- liquid extraction

The Basic Process of Extraction. The Difference between Extraction and Washing. Identifying the Aqueous Phase and the Organic Phase. How much solvent/ how many extractions? . Techniques and methodologies for the isolation, characterization and quantitation of natural products (such as nicotine from tobacco ,caffeine from coffee and tea ,limonine from lemon and piprene from black pepper).

APCH 316:*Applied Organic Chemistry 3 (Reaction Mechanism)* **2 Cr.Hr. (L2+P0)**

Prerequisite: CHEM 211

Kinetic and non-kinetic studies, substitution reactions, electrophilic and nucleophilic aromatic substitution - free radical reactions -carbonium ions and electron deficient N and O atoms, carbonium ion reaction, rearrangements with and without change in carbon skeleton. Stereochemistry of rearrangement. Wolff rearrangement. Diazonuim cations, - electrophilic and nucleophilic addition to -C=C-, -addition /elimination -stereoselectivity in carbonyl compounds, addition reaction- addition/ elimination reactions of carboxylic derivatives, 1,2 elimination (E1 , E2 CB and E2 mechanism) –Substituation- effect of activating group-, other 1,2- elimination, -syn elimination.

APCH 324:*Inorganic chemistry* **2Cr. Hr. (L2+P0)**

Prerequisite: CHEM 222

Part 1: Glass Chemistry: Introduction, Specification for materials required for glass industry, Sources of rowmaterials.Types of row materials, some important raw materials [sand (chemical analysis, mechanical analysis)- sodium carbonate (chemical analysis)- calcium carbonate (chemical analysis)- $CaCO_3$. $MgCO_3$- Felespare- Borax- red Lead oxide- Cullet- Blast Furnace slag- Other oxides (P_2O_5, NiO, CoO, CuO, Fe_2O_3, ZnO, SnO_2, Sb_2O_3, MgO) .Batches Calculation, Glass Industry.

Part 2: Ceramic Chemistry: Introduction to Ceramics, Milling and equipment. Slip preparation procedure.Forming [drying a slip- granulation- die pressing- isopressing- slip-costing procedures- extrusion- injection Melding], Firing, effect of processing on properties of ceramic (cancelled).Ceramic properties measurements, physical and mechanical properties of ceramic.

APCH 326:*Inorganic Chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 222

Part 1: Nano Chemistry (1): Introduction: Particle size and characteristics. Production of nanomaterials: Amalgamation of bottom up chemistry and top down techniques.Methods of characterization including recent microscopic methods. Description of the concepts and methods developed for synthesizing range of nanoscale building blocks with strictly controlled size, shape, bulk and surface structure and composition, and properties. Explanation of how these nanoscale construction units can be organized and integrated into functional architectures

using a combination of self-assembly templating, chemical lithography and other patterning methods.

Part 2: Solar Chemistry (1): Basics of Solar and Light Energy including light energy conversion. Solar cells. Solar Reactors and solar collectors: Design and technology. Solar Furnace and Production of Materials. Efficiency of solar collectors, receivers and concentrated solar collectors. Thermodynamic Cycles and power generation.

APCH332:*Analytical Biochemistry* **2Cr. Hr. (L2+P0)**

Prerequisite: CHEM 231

Modern analytical chemistry and biochemistry methods of a host of biological species. Fundamental processes of life require metal ions, including respiration, nitrogen fixation, photosynthesis, and replication. Selection and regulation of metal atoms and ligand systems, and the interactions with their corresponding protein environments. The course will emphasize the chemistry of transition metals and their importance in catalytic processes, atom transfer, and electron transport. The array of physical methods required for study will be introduced, with application toward the determination of electronic and molecule structure, and enzymatic mechanisms.

APCH 334:*Analytical Chemistry D(Food and Ore Analysis)* **2 Cr. Hr. (L2+P 0)**

Prerequisite: CHEM 231

Structure and properties of food components (water, carbohydrates, proteins, lipids, other nutrients, food additives). The chemistry of changes occurring during processing, storage and utilization. Principles, methods and techniques of qualitative and quantitative physical, chemical and biological analyses of food, food ingredients, and ores. Analysis of industrial products such as metals,cement , fertilizers, alloys , dyes and pigments , textiles , glass and ceramics, petrochemicals and drugs

APCH 335:*Analytical Chemistry B* **1 Cr. Hr. (L1+P 0)**

Prerequisite: CHEM 231

Part 1:Quality concept, dimensions and management:

Activities for maintaining quality. Quality management. Total quality management. Quality assurance (QA). Quality control. Types and sources of errors. Control charts. Control samples. Method validation. Trueness, precision, reproducibility, repeatability, accuracy, uncertainty, sensitivity, linearity, rigidness-Test and t-test. Data Graphical Representation (Line graph, Bar graph, Dot plot, Pie chart, Scatter plot, trend graph, Pictograph, Histogram).Outliers

Part 2: ISO standards:

ISO 9000 : Quality management, ISO 14000: Environmental management, ISO 17025: Competence of testing and calibration laboratories ISO 18000: Occupational health and safety, ISO 22000: Food safety management, ISO 27001: Information security management, ISO 31000: Risk management, ISO 50001: Energy management

APCH 337:*Analytical Chemistry C (Chemometric and Experimental designs)* **1 Cr. Hr. (L1+P 0)**

Prerequisite:CHEM 231

Types and handling of errors in quantitative analysis; statistics of repeated measurements; significance tests; sampling and quality of measurements; regression and correlation in calibration methods of instrumental analysis; non-parametric and robust methods; experimental design and optimization techniques in chemistry; multivariate analysis.

Practical: related to the above topics.

APCH 341:*Applied Physical Chemistry (1)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM241

Part 1: Electrochemistry [2] (Kinetics of electrochemical reactions/Irreversible electrode processes): Polarization and overpotential. Measurement of polarization. Causes and types of polarization. Resistance polarization. Concentration polarization and oxygen reduction reaction. theories of rotating disc electrode, rotating ring electrode & their applications Activation polarization, Butler – Volmer equation, Tafel Equation. Real polarization Curve (I-E voltammogram), Methods of determining the current-overpotential curves (Tafel plots) and cathodic hydrogen evolution reaction.

Part 2: Thermodynamics of electrolytic solutions (Electrochemistry): Electrolytic solutions and electrical double layer, electrolytic solutions, electrical conductance, Arrhanuis theory for electrolytic dissociation, migration of ions, mobility of ions, transport number, deviation of electrolytic solutions from ideal solutions, Van't Hoff factor, solvation, activity and activity coefficient, partial molar quantities, Debye and Huckel's theory for strong electrolytes, ionic association theory. Models of electrical double layer. Capacity of electrical double layer.

APCH 342:*Applied Physical Chemistry (2)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM242

Part 1: Physical Properties of Polymers: Introduction to polymer Science, classification of polymers, characterization of polymers, physical states transitions and degradation,Glossary and chemical formulas of a series of polymers. Macrogalleria. Specific features of polymers. Types of Interaction. Chain flexibility. Thermomechanical curves of polymers. Mechanisms of polymerization,Molecular weight determination. Mechanical Properties of Polymers. Polymer Processing. Polymer testing. Polymers for hightech.: Nanocomposites, LC polymers, Carbon Fibers, Polymers in medicine ...etc

Part 2: Surface Chemistry [2]: Gas-solid and liquid-solid interface: Sorption–adsorption of gases, factors influencing adsorption , physisorption and chemisorption, potential energy in relation to surface structure, monolayer capacity – extent of adsorption, heats of adsorption, theories of adsorption: Freundlich equation , Langmuir theory and multimolecular theory (BET), determination of the specific surface area, surface area in the pores structure, thickness of the adsorbed layer in the capillary condensation region, adsorption from solution, mechanisms of adsorption, adsorption isotherms, pore size determination, determination of acidic properties on solid surfaces, acid strength, acid amount.

APCH 343:*Applied Physical Chemistry (A)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM242

Part 1: Colloids: Classification of colloidal systems, colloidal dispersions, sols, preparation, purification and properties of sols, coagulation of sols, stability of sols, protection of sols, associated colloids (micelles), preparation and properties of emulsions, edible emulsions, gels,aerosols (classification and properties), macromolecules, colloidal systems in our life (applications).

Part 2: Statistical Thermodynamics: Introduction. Classical thermodynamics, Classification scheme and fundamental for statistical thermodynamic. Probability and statistics. The ensemble method and the two basic postulates of statistical thermodynamics. Statistical modeling for thermodynamics. Thermodynamic properties of the ideal gas. Statistical thermodynamics for ideal gas mixtures

APCH 344:*Practical Applied Physical Chemistry* **1 Cr.Hr. (L0+P 3)**

Prerequisite: CHEM242

Experiments on catalysis, applied surface and thermodynamic chemistry

and flourishing of flowering plants - Study of different plant fossil examples, their classification and illustrations - How to obtain fossil specimens from their natural environment - The relation between Palaeobotany, palaeoecology and the palaeoclimate - Fossil plants of Egypt.

BOTA 304: Selected Families of Flowering Plants 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 202)
- Introduction to the systems of classification (Engler) - Monocotyledonous orders and families - Dicotyledonous orders and families - Achlamydeae / Monochlamydeae.
- Dialypetalae – Choripetalae – Sympetalae - Keys.

BOTA 305: Molecular Genetics 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 207)
Introduction - The molecular structure characteristics of Eukaryotic chromosome - The composition and structure of both nucleic acids (DNA and RNA) - Cell cycle - DNA replication - Transcription , RNA molecules and RNA processing - The genetic code and the translation of genetic message - Extranuclear genetics - Metabolomic - DNA microarray - Transposable elements in prokaryotes - Mutations - DNA repair mechanisms.

BOTA 306: Fresh Water and Marine Algae of Egypt 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA 206)
A survey of marine and fresh water algae in different Egyptian water resources, field collection of different algal samples, identification and observation, morphological, physiological and ecological adaptations of fresh and marine water algae to their environment.

BOTA 307: Plant Tissue Culture and its Biotechnological Application 3 Cr. hr. (L2 + P2)
Prerequisite: (BOTA --)
- Introduction to plant tissue culture - What do plant cells need to multiply *in Vitro*-
The history and development of plant tissue culture - Setting up a plant tissue culture laboratory - Sterilization methods - The culture of plant organs: 1- Excised root culture 2- Stem tip and shoot culture 3- Leaf culture 4- Pollen, anther and ovule culture 5- Embryo culture: a- Types of embryo culture b- Applications of embryo culture - The culture of plant cells: 1- Callus culture 2- Cell suspension culture - Plant Regeneration: 1- Somatic Embryogenesis 2- Organogenesis - Some applications of plant tissue culture: 1-Micropropagation 2-Protoplast isolation and Fusion - *In vitro* production of secondary metabolites

BOTA 308: Bioinformatics and Biostatistics of DNA and Protein Analysis 1 Cr. hr. (L1 + P0)
Prerequisite: (STAT 209)
What is meant by "Bioinformatics" or "Molecular Biology in silico" - Origin of Bioinformatics sciences and importance of its studying - Bioinformatics and Omics: analyses of biological systems - Bioinformatics and biological structures (i- Bioinformatic Analyses and Gene Distributions and Expression - ii- Predection of protein structure and classification of protein domain) - Bioinformatics and inferring functions of genes and/or proteins - Bioinformatics and applications - Overlapping of Bioinformatics and Biostatistics - Biostatistics tools to study sequences, gene expression and structure prediction (graphical and numerical descriptive statistical techniques - probability calculations and probability distribution - hypothesis testing, correlation, and linear regression.)

BOTA 309: Technology of Seed Germination, Macro-and Micropropagations 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA --)

APCH 346:*Applied Physical Chemistry (B)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM243

Part 1: Advanced Chemical Kinetics: Substitution reactions of metal complexes, factors affecting the rate of substitution reactions (A, D and I mechanisms), acid hydrolysis, base hydrolysis, anation reactions. Oxidation-Reduction reactions: inner sphere reactions, outer sphere reactions, one equivalent-one equivalent reactions, one equivalent-two equivalent reactions, two equivalent-two equivalent reactions, multiequivalent reactions, catalytic reactions.

Part 2: Quantum Chemistry: Introduction to quantum mechanics, Wave mechanics (simple harmonic motion, Wave equation and commutation relation. Schrodinger equation and its principles, Application of Schrodinger equation (particle in a one dimension box), Three dimensional rectangular box, Postulates of quantum mechanics, vibration motion and rotation motion, Linear combination of atomic orbital and molecular orbital theory for conjugated systems,Huckles approximation. Spectra.

Course Contents of Botany Department

BOTA 301: Physiology of Plant Growth, Development, Phytohormones and Their Biotechnological Applications **3 Cr. hr. (L2 + P3)**

Prerequisite: (BOTA --)

The mechanism of cellular growth and development. Growth kinetics in annual and perennial plants. Control of growth and development and conditions of their enhancement. The correlation between gene expression and plant growth. The chemical factors that regulate growth and development including auxins, gibberellins, cytokinins, abscisic acid, ethylene, salicylate, brassinosteroids and jasmonate. The metabolism & mechanism of action of the mentioned growth regulators and their regulatory roles in physiological processes. Physiology of flowering including photoperiodism, vernalizalion and dormancy. The commercial applications of all the previous growth regulators as powerful agents in agricaltural uses. The correlation between the phytoregulators and the gene action.

BOTA 302: Molecular and Functional Characterization of Transport in Plant and Mineral Nutrition **3 Cr. hr. (L2 + P3)**

Prerequisite: (BOTA 203)

I. Molecular and functional characterization of transport in Plant: Protein structure and function - Biomembrane structure - Transmembrane transport of ions and small molecules - Uniport transport - ATP powered pumps - Non gated ion channels - Co-transport by symporters and antiporters- Signal transduction pathway and second messenger concept – G-protein and Ca^{2+} as messengers.

II. Mineral Nutrition: Classification of nutrients into macronutrients and micronutrients - Functions of mineral nutrients in plant growth and development - Symptoms of deficiency and toxicity of these nutrients.

BOTA 303: Palaeobotany **2 Cr. hr. (L1 + P2)**

Prerequisite: (BOTA 204)

Basic principles of the course - The fossilization, different strategies concerning the fossilization procedures and histories - Different types of plant fossil specimens - The techniques used to study the different plant fossil specimens - The ancient ages (geologic ages) and the different eras of plant life history - Theories concerning the origin and evolution of Bryophytes and Pteridophytes - The origin and evolution of Gymnosperms - The appearance

1. Physiology of germination (1/2 hr theoretical per week): Imbibition of water and metabolic activation of imbibed seeds - radicle growth and penetration of testa - Modulation of phytohormone ratios during germination – Inhibitors of seed germination – Mobilization of food reserves in cereal grains and dicot seeds: Responsible enzymes and their genes and hormonal regulation – Seed dormancy and its types – Requirements in some seeds for after-rippening, chilling and light – Dormancy – specific proteins – Hormonal changes during dormancy break – Biochemical and cellular aspects related to dormancy. Applied aspects and technologies related to germination and dormancy.

2. Macro- and micro-propagations (1/2 hr theoretical per week)

Plant 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.

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

BOTA 310: Polymerase chain reaction (PCR): Principles and Applications 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA 209)

The Procedure - The enzyme - Reaction specificity - Contamination of PCR reactions - Instruments for the PCR and product analysis - Different schemes of PCR - Inverse PCR - Anchored PCR - PCR for site directed mutagenesis by overlap extension - Asymmetric PCR for DNA sequencing - In situ PCR - Applications of PCR (e.g. study of DNA polymorphism, gene tagging, and confirming the presence of transferred gene etc.).

BOTA 311: Molecular Diagnosis 2 Cr. hr. (L1 + P2)

Prerequisite: (BOTA 209)

Introduction - What is molecular diagnostics? - Why use molecular diagnosis? - Hybridization based methods - Reverse hybridization methods - Diagnostics based on DNA chips and Micro-arrays - detailed study of Nucleic acid amplification-End-point PCR-Qualitative - detailed study Nucleic acid amplification- Real time PCR-Qualitative and Quantitative - Molecular diagnosis by nanotechnology (Gold nanoparticles) - Immunological diagnosis (principles and techniques).

BOTA 312: Plant Communities and Environmental Biotechnology 2 Cr. hr. (L2 + P0)

Prerequisite: (BOTA 205)

Concept of plant community - Physiognomy and structure of plant communities - Plant succession (hydroxere and xeroxere) and Climax – competition of plant species and its effects – classification of vegetation - Quantitative and qualitative characteristics of plant communities - Genetic resources – Gene and Seed banks and other genetic resources banks - biosphere reserves (germplasm) etc. - Techniques used in Genetic resources conservation.

BOTA 313: Applied Phycology 2 Cr. hr. (L2 + P0)

Prerequisite: (BOTA 206)

Fossil algae and its applications, Medicinal algae, Algae and its uses in the field of industries, Algae and food science, Algae as a bioindicators for water Quality, Algae in sewage treatments, Algal Toxins.

BOTA 314: Phytogeography **1 Cr. hr. (L1 + P0)**

Prerequisite: (BOTA --)

Introduction, Identification and purposes of phytogeography - Life forms of plants - The world terrestrial biomes: A forest biome in temperat and cold regions, grassland biome (Savanah, Prairie, Steppes, desert and semidesert biome – Tundra and alpine biome) - Ecological factors affecting vegetation (A climatic, edaphic, topographic, biotic and a biotic factors).

BOTA 315: Plant Hormones and Their Applications **2 Cr. hr. (L1 + P2)**

Prerequisite: (BOTA 102)

- The main concepts of growth regulators as chemical messengers.
- Classes of phytohormones: Auxins – Gibberellins – Cytokinins, Abscisic acid – Ethylene – Brassinosteroids – Salicylic acid – Jasmonic and methyl jasmonate.
- Introduction – occurrence – Biosynthesis and degradation – Transport – Physiological roles – commercial applications.

BOTA 316: Biodiversity **1 Cr. hr. (L1 + P0)**

Prerequisite: (BOTA --)

- Introduction, Concept of Biodiversity, its origin & development, Definition, past history, ranks recognized in biodiversity studies. - Aims and objectives of Biodiversity; Levels of biodiversity, Measurment of Genetic diversity and community diversity.- Magnitude and distribution of biodiversity; Current magnitude of Global biodiversity, botanical regions & hot spots, Endemism and biodiversity.- Dgeneration maintainance and Loss of biodiversity; Diversification of species, ecological extinctions, proximate causes. - Inventorying, monitoring and Assessment of resource base for bio dived.- Biotechnology & biodiversity: Assessment and use of molecular DNA data on biodiversity - Application of biotechnology for the utilization of biodiversity - Economic value and utilization of biodiversity with reference to food, fodder, fiber, oils, drugs... - Biology and diversity of Algae and Bryophytes - Biodiversity of pteridophytes, gymnosperms and palaeobotany - Biology and diversity of Virsus and Bacteria.

BOTA 318: Application of Fossil Plants **1 Cr. hr. (L1 + P0)**

Prerequisite: (BOTA 204, 206)

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

BOTA 320: Plant Breeding and its Applications **1 Cr. hr. (L1 + P0)**

Prerequisite: (BOTA --)

Plant Breeding objectives - Some Terms - Polyploidy - Heterosis - Selection methods in plant breeding based on mode of reproduction - inbreeding - Some type of inbreeding in diploid plant - Effects of Ploidy on Inbreeding Depression - Modern techniques in plant breeding - Markers for Genetic Mapping - Biochemical Polymorphism and Protein variation - Molecular markers - Techniques used for analysis of molecular markers - Molecular Marker Techniques - PCR Based Molecular Markers.

BOTA 321: Physiology of Plant Growth and Phytohormones – Plant Tissue Culture 3 Cr. hr. (L2 + P3)

Prerequisite: (BOTA --)

Physiology of plant growth and phytohormones

One hour lecture and 1.5 hours practical per week

Growth, development and differentiation. The mechanism of cellular growth and development. Growth kinetics in annual and perennial plants. Control of growth and development and

conditions of their enhancement. The correlation between gene expression and plant growth. The main concepts of growth regulators as chemical messengers

Classes of growth regulators (phytohormones): Auxins - Gibberellins – Cytokinins - Abscisic acid – Ethylene introduction, Occurrence biosyntheses, Degradation and conjugation, Transport, Mechanism of action – Physiologial roles – Commerical applications.

Plant tissue culture Introduction – basic materials and methods of plant tissue culture techniques – the culture of plant organs – the culture of plant cells – the culture of higher plant protoplasts – organogenesis – somatic embryogenesis – some applications of plant tissue culture techniques- Introduction to plant biotechnology.

BOTA 322: Principles of Archegoniates **3 Cr. hr. (L2 + P2)**

Prerequisite: (BOTA –)

The systematic position of archegoniates between other living organisms. The archegoniates general characters and classification. Comparative study between Bryophytes, Pteridophytes and Gymnosperms, main divisions and taxa. Discuss the evolutionary lines in the course. Importance of archegoniates

BOTA 323: Basic Genetic Mechanisms **2 Cr. hr. (L1 + P2)**

Prerequisite: (BOTA 217)

Introduction - The molecular structure characteristics of Eukaryotic chromosome - The composition and structure of both nucleic acids (DNA and RNA) - Cycle cell – Replication of nuclear DNA – DNA repair and its mechanisms – DNA recombination – Organellar DNA - DNA Transcription – Characteristics and functions of RNAs- RNA processing – RNA editing – Molecular mechanisms of mRNA turnover - The genetic code and the translation of genetic message.

BOTA 324: From Protein Sorting to Protein Engineering **1 Cr. hr. (L1 + P0)**

Prerequisite: (BOTA 217)

Introduction – The machinery of protein sorting – Targeting and transport of proteins to/into cellular organelles – Transport in and out of nucleus – The role of ER in protein sorting and assembly – Vacuolar targeting – Interactions between bio-molecules (Chemical and physically)- Types of protein inter and intra interactions- Protein: protein- protein: DNA-protein: RNA- What is meant by "protein engineering"? - Objectives for protein engineering- Techniques for protein engineering- Engineering the protein fold – Enzymes by design – Challenges of protein engineering.

BOTA 325: Algae of different habitats in Egypt **2 Cr. hr. (L1 + P2)**

Prerequisite: (BOTA 213)

Fresh water algae in Egypt – Marine habitat in Egypt – Identification of fresh water species and marine taxa – Environmental factors affecting the growth of fresh and marine water algae – Field collection of algae from different water resourses.

BOTA 326: Wildlife and Environmental Natural Resources **1 Cr. hr. (L1 + P0)**

Prerequisite: (BOTA 215)

Approaches to Wildlife Management (Preservation, Conservation, Management)- Habitat diversity - 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.

BOTA 327: Abiotic Stresses and Strategies of Their Tolerance in Plants 1 Cr. hr. (L1 + P1)

Prerequisite: (BOTA --)

a- Water deficit and drought tolerance: Drought stress, plant growth, induction of ABA biosynthesis, leaf abscission – retardation of photosynthetic rate, increase resistance to water flow and deposition of leaf wax. ABA-dependent and independent signaling pathways and regulation of stress tolerance.

b- Salinity stress: Salt stress injury - different strategies to alleviate salt stress - Salt tolerance genes.

c- Heat stress and heat shock: High temperature, photosynthesis, respiration - membrane stability – High temperature and plant protective proteins. Heat shock proteins (HSPs) mediate tolerance to high temperatures. Several signaling pathways mediate thermotolerance responses.

d- Chilling and freezing stress: Membrane damage in response to chilling injury - Acclimation to freezing induces ABA and protein synthesis.

e- Flooding stress and oxygen deficiency: Oxygen deficiency and root damage followed by shoot damage - Anatomical changes during hypoxia and the formation of air cavities - Synthesis of anaerobic stress proteins.

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.

BOTA 329: Molecular Diagnosis: Principles and Applications 1 Cr. hr. (L1 + P1)

Prerequisite: (BOTA 217)

General introduction to molecular diagnosis – Purposes of using molecular diagnosis Detection methods - Hybridization based methods (Fluorescence in situ hybridization) - Nucleic acid amplification based methods - Qualitative and Quantitative Real time PCR – Diagnostic sequencing – Diagnostics based on DNA chips and Micro-arrays- Automation and gene therapy; applications in diagnosis of genetic disorders (human genome project and ethical considerations) – Protein- based diagnostics methods - Immunological diagnosis (principles and techniques) – Considerations of molecular diagnostics are microbe dependant.

BOTA 330: Applications of Environmental Conservation 1 Cr. hr. (L1 + P0)

Prerequisite: (BOTA 215)

Biodiversity and land conservation - Conservation and the ecosystem approach - Conservation and climate change - Convention on Biological Diversity thematic areas (Marine biodiversity, Inland waters, Agricultural Biodiversity, Dry lands Biodiversity, etc..) - Protected Areas Conservation – Biodiversity/Conservation monitoring - Protected areas (The future challenges and outlines possible ways forward).

BOTA 331: Principles of Palynology and their Applications 1 Cr. hr. (L1 + P1)

Prerequisite: (BOTA 216)

Introduction - Source of recent and fossil pollen & spore - Compostion, structure of pollen grains and spores, development of pollen grains wall, apertures, shape of pollen grains and spores, sculpturing - The taxonomic significance of pollen morphology - Numerical approaches to pollen identification - Collection and treatment of samples - Application of palynology; taxonomy, honey studies, climatic change, tracing vegetation history, forensic science, Allergy and petroleum studies.

BOTA 333: Plant Tissue Culture (Biochemistry) 2 Cr. hr. (L1 + P2)
Prerequisite: (BOTA --)
Introduction – basic materials and methods of plant tissue culture techniques – the culture of plant organs – the culture of plant cells – the culture of higher plant protoplasts – organogenesis – somatic embryogenesis – some applications of plant tissue culture techniques- Introduction to plant biotechnology.

BOTA 334: Stress Physiology and Antioxidant System in Plants (Biochemistry) 2 Cr. hr. (L2 + P0)
Prerequisite: (BOTA --)
a- Water deficit and drought tolerance: Drought stress, plant growth, induction of ABA biosynthesis, leaf abscission – retardation of photosynthetic rate, increase resistance to water flow and deposition of leaf wax. ABA-dependent and ABA-independent signaling pathways and regulation of stress tolerance.
b- Salinity stress: Salt stress causes multiple injury effect - Plants use different strategies to alleviate salt stress - Salt tolerance genes.
c- Heat stress and heat shock: High temperature, photosynthesis, respiration - membrane stability – High temperature and plant protective proteins. Heat shock proteins (HSPs) mediate tolerance to high temperatures. Several signaling pathways mediate thermotolerance responses.
d- Chilling and freezing stress: Membrane damage in response to chilling injury - Acclimation to freezing induces ABA and protein synthesis.
e- Flooding stress and oxygen deficiency: Oxygen deficiency and root damage followed by shoot damage - Anatomical changes during hypoxia and the formation of air cavities - Synthesis of anaerobic stress proteins.
f- Heavy metal stress: Definition – Toxicity – Polypeptide induced by heavy metals – Metallothioneins – phytochelatins – Heavy metal tolerance – Soil decontamination (phytomining and phytoremediation).
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.

BOTA 335: Medicinal Aromatic and Economic Plants (Microbiology- Biochemistry) 2 Cr. hr. (L2 + P0)
Prerequisite: (BOTA 101, 102)
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; 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.
Economic plants: Introduction, studies of the natural plant sources and the continuous improvement for their exploitation and their economic uses - Studying examples of economical plants and their industrial uses; food, fiber, wood and cork plants, rubber and plant latex products, Fatty oils and wax plants, Aromatic plants (oil essential plants), sugar, starch and cellulose plants, spices plants, Beverages, Fumitory and masticatory plants, biofuel producing plants. Gums, resins, tannin plants.

Courses content of the biochemistry department

BIOC 301: Body Fluids and Biological Functions **4Cr. Hr. (L3+P3)**

Prerequisite: BIOC 201 or BIOC 203

This course aims to provide the students with the basic knowledge about the body fluid compartments, types and functions of body fluids and biological function of different organs of the body. This course also, aims to develop a broad understand of the blood composition and functions and normal and abnormal functions of lung, kidney, and liver with its specific measurements.

BIOC 302: Vitamins and Inorganic Metabolism **4Cr. Hr. (L3+P3)**

Prerequisite: BIOC 201

The course aims to provide the students with the basic knowledge about vitamins. As well as, the course highlights the different types, chemical structures, sources, functions, absorption and metabolism of vitamins. In the mean time, the course presents the different diseases those results due to the deficiency or surplus of vitamins in basic human nutrition. Also, this course aims to provide the students with the core knowledge and understanding of the metal trafficking in cells; the role, uptake, and fate of elements essential for life and the response of living organisms to toxic inorganic substance. Understanding metal homeostasis within the general context of cell metabolism, how the complex molecular mechanism behind is regulated. Generally, it provides the basic on dietary minerals and the essential trace minerals biochemistry.

BIOC 303: Molecular Biology I **3Cr. Hr. (L2+P3)**

Prerequisite: BIOC 201

This course aims to provide the students with the basic knowledge about the basic structure of nucleic acids; DNA and RNA, including different types of nitrogenous bases. Also, this course aims to provide the students with the core knowledge about DNA replication, DNA transcription in prokaryotic cells and translation of RNA transcript into proteins.

BIOC 304: Microbial biochemistry **2Cr. Hr. (L2+P0)**

Prerequisite: MICR 102

This course aims to provide students with the biochemical ecology of diverse microbial growth, metabolism and microbial genome. Also, the course presents the main biochemical activities of microorganisms emphasizing the similarities and differences between microbes and eukaryotes. In the mean time, the course discusses the importance of these biochemical capabilities as microbial toxins, biodegradation, microbial transformations, and secondary metabolites.

BIOC 306: Immunology **3Cr. Hr. (L2+P3)**

Prerequisite: BIOC 201

This course aims to provide the students with the basic knowledge about the human body immune system and the different types of immune responses, as well as the clinical importance of the antigen-antibody interactions and the different undesirable immune reactions. Also, it allows the students to know how the immune system can be involved in either defending the body against infection and some cancers, or itself giving rise to tissue damage or tumors.

BIOC 307: Radiation Biology **2Cr. Hr. (L2+P0)**

Prerequisite: --

This course aims to introduce students to the concepts of radiation and radioactive isotopes to ensure that they have the necessary knowledge to be able to recognize the risks and benefits of their use in biology. The course includes introduction to radiation – interaction of radionuclides with matter – biological effects of radiation - radiation safety - different application of radiation in imaging, laboratory and radiation therapy.

BIOC 308: Endocrinology **2Cr. Hr. (L2+P1)**

Prerequisite: BIOC 201 or BIOC 202

The overall aim of the course to demonstrate the wide background knowledge related to endocrine glands and their hormones, their effects on the metabolism and to recognize the relationship and interactions between the different hormones.

BIOC 310: Nucleic acid metabolism **3Cr. Hr. (L2+P3)**

Prerequisite: BIOC 201

The course aims to provide students with basic knowledge about purines and pyrimidines structure and metabolism, as well as disorders that are related to defect in their metabolism.

BIOC 311: Terminology **2Cr. Hr. (L2+P0)**

Prerequisite: --

This course illustrates the origin of the scientific terminology and builds an understanding of the etymology or origin of words, and how to break them into component parts (prefix-root-suffix). The course explains scientific expressions and shows the words' roots as the main part of the scientific expressions. Roots can be combined with other roots to make more complex words such as the word electrocardiogram. In addition, the course shows how the prefixes and suffixes may also be added to words to modify the meaning.

BIOC 312: Nutrition **2Cr. Hr. (L2+P0)**

Prerequisite: BIOC 202

This course aims to provide the students with components of a healthful diet from the basic groups of food in addition to main food biohazards and to understand the problems of over food diseases, deficiency diseases and contamination diseases. In the meantime, discuss consequence of malnutrition and under nutritional facts.

BIOC 314: Principles of Nucleic Acid Metabolism **2Cr. Hr. (L2+P1)**

Prerequisite: BIOC 201

This course aims to enable the students to keep the key concepts about the biosynthesis, degradation, metabolism and regulation of purines and pyrimidines nucleotides. This course also discusses the disorders related to abnormalities of these metabolic pathways.

BIOC 316: Hormones and Signal Transduction **3Cr. Hr. (L2+P2)**

Prerequisite: BIOC 201 or BIOC 202

The course aims to develop a broad knowledge of hormone characteristics, the diverse mechanism by which different classes of hormones exert their actions and the regulation of hormonal secretion. Also, the course emphasizes the detailed mechanism of the hormonal signaling system that regulates the cellular behavior.

BIOC 309: Introduction to biological fluids **3Cr. Hr. (L2+P3)**

Prerequisite: BIOC 203

This course aims to provide the students with the basic knowledge about the different types of body fluid compartments as well as the composition, formation and functions of selected body fluids. The course also aims to emphasize the students with the normal and abnormal constituents of body fluids and their clinical correlation.

BIOC 322: Introduction to Biotechnology **2Cr. Hr. (L1+P2)**

Prerequisite: --

This course introduces both the principles and the applications of recombinant DNA technology to animals, plants and microbial organisms. The course describes the use of genetically engineered products to clean the environment and improve human health.

BIOC 326: Introduction to immunology **2Cr. Hr. (L2+P0)**

Prerequisite: BIOC 201

This course aims to provide students with the basic knowledge about the immune system components and explains how the immune system fights diseases and infections. Also, the course emphasizes the role of B-cells and T-cells in the specific immune system as well as the different types of allergy.

ملحوظة:

تم تعديل رقم المقرر **BIOC 306** بعنوان:**مناعة** المقرر تدريسه بالفصل الدراسي الثاني لبرنامج الفيزياء الحيوية - تخصص منفرد الي الرقم: **BIOC 326** بعنوان: **مقدمة في علم المناعة.**

مرفق توصيف لجميع المقررات الخاصة بالمستوي الثالث.

Course contents of the Microbiology Department

MICR 312: Taxonomy of Viruses **3 Cr.Hr. (L2+P2)**

Prerequisite: MICR 212

1-Plant Virology: Major properties of plant viruses, Basis of their classification, representative plant viruses members to each group including viruses structure, their economic importance, hosts, symptoms, methods of transmission, diseases and control).

2- Animal Virology: physical and chemical properties of animal viruses, method of propagation, purification and assay, Mechanism of viral replication and pathogenesis of viral infections in animals. Classification of animal viruses (representative members to each group including viruses structure, their economic importance, hosts, symptoms methods of transmission, diseases and control).

MICR 314: Bacteriophage **2 Cr.Hr. (L1+P2)**

Prerequisite: MICR 212

History, biology and diversity; role of phages in bacterial virulence, phage applications (as biocontrol agents, phage therapy, phage display, detection of bacteria), phage-biofilm interaction, phage endolysin, large scale production of phages, examples of commercially available phage products, problems caused by phages in the industry, phage host range, bacterial resistance mechanisms.

MICR 321: Taxonomy of Bacteria **3 Cr.Hr. (L2+P2)**

Prerequisite: MICR 221

Microbial life and evolution; Microbial diversity and specification; Phylogeny of living world; Principles of bacterial taxonomy (Classification, nomenclature and identification); Criteria used in bacterial taxonomy; Defining taxonomic ranks and higher taxa; Eubacteria vs. Achaea, Bergey's classification; Towards modern taxonomy; Groups of prokaryotes and selected examples (Significant taxonomic criteria and importance).

MICR 322: Actinomycetes **2 Cr.Hr. (L1+P2)**

Prerequisite: MICR 221

History of actinomycetes; Morphology of actinomycetes; Actinomycetes cell structure; Spore formation by actinomycetes; Criteria used for description and classification of actinomycetes; Classification systems used for actinomycetes classification; General characteristics of different actinomycetes groups; Description of important genera; Molecular techniques to study diversity of actinomycets; Phylogenetic study of actinomycetes.

MICR 331: Taxonomy of Fungi **3 Cr.Hr. (L2+P2)**

Prerequisite: MICR 231

Introduction (Overview of the world of fungi and general characteristics; Kingdoms, Classification and biodiversity; A mixed bag: Protozoan, pseudofungi (the so called Slime moulds, phyla Myxostelida, Dictostelida, Labrinthulida, Plasmodiophorida); Chromistan fungi (Phyla Hyphochytriomycota and Oomycota), Eumycotan fungi (phylum 1 Chytridiomycota); Review and feedback activities; Eumycotan fungi, phylum 2 Zygomycota; Phylum 3 Dikaryomycota, Subphylum 1 Ascomycotina: The Ascomycetes; Phylum 3 Dikaryomycota, Subphylum 1 Basidiomycotina: The Basidiomycetes; Review and feedback activities

MICR 352: Geomicrobiology **1 Cr.Hr. (L1+P 0)**

Prerequisite: MICR 221, MICR 231

The biosphere as a microbial habitates, Geomicrobial processes, A physiological and biochemical overview; Methods in Geomicrobiology; Cell surface, reactivity and metal

sorption; Biomineralization; Microbial weathering; Microbial leaching. Oil reservoirs and oil production- Introduction to bioremediation of petroleum hydrocarbons- Biodegradation of petroleum in subsurface geological reservoirs- Reservoir souring: mechanisms and prevention- Biofouling in the oil industry- Microbially enhanced oil recovery- The Microbiology of marine oil spill bioremediation

MICR 353: Soil Microbiology **2Cr.Hr. (L1+P2)**
Prerequisite: MICR 221, MICR 231.
The study of biota that inhabit the soil and the processes that they mediate. The course covers the topics of soil structure and genesis. The structure of the lithosphere. Biogeochemical cycling. Plant microbial interaction including the biological control and the phytopathogic microorganism. Biocides and biofertilizers. Mangment of soil organisms and their processes in soil.

MICR 355: Food Microbiology **2Cr.Hr. (L1+P2)**
Prerequisite: MICR 221, MICR 231.
Food as substrate of microorganisms, studying important groups of microorganisms associated with food spoilage, food fermentations, food contamination and intoxications. Intrinsic and extrinsic factors and their relationship to microbial growth on food stuff, control of microorganisms by food processing, detection of foodborne pathogens in different food products; application of Hazard Analysis Critical Control Points (HACCP) programs to enhance food safety, food preservation.

MICR 361: Molecular Biology II **1 Cr.Hr. (L1+P 0)**
Prerequisite: MICR 262
The chemical components of a cell including different level of proteins and lipids structure. Internal organization of the cell focusing on structure, transport of small molecules and the electrical properties of membranes. Laser and Laser tweezers. Cell communication especially in microorganisms (quorum sensing). Biosensors, microbial whole cell biosensor, DNA microarrays - principles and applications in molecular diagnostics. DNA sequencing and analysis using internet. Other advanced techniques in molecular biology. Extended topics to be covered include methods in recombinant DNA technology, microarrays, and microRNA.

MICR 372: Microbial Physiology and Metabolism **3 Cr.Hr. (L2+P2)**
Prerequisites: MICR 221, MICR 231
Comparison of procaryotic and eukaryotic cell structure and function; Microbial Nutrition: The Common Nutrient Requirements; Uptake of Nutrients by the Cell; Culture Media; Microbial Growth: The Growth Curve; The Continuous Culture of Microorganisms; The Influence of Environmental Factors on Growth; Microbial Metabolism: The Role of ATP in Metabolism; Oxidation-Reduction Reactions and Electron Carriers; Electron Transport and Oxidative Phosphorylation; Anaerobic Respiration; Photosynthesis; The Photosynthetic Fixation of CO_2; Synthesis of Sugars Polysaccharides; Amino Acids; Purines, Pyrimidines, and Nucleotides, Lipid Synthesis; Synthesis Patterns of Cell Wall Formation.

MICR 374: Microbial Transformations **2 Cr.Hr. (L1+P2)**
Prerequisite: (MICR221, MICR231)
Types of microbial bioconversion reactions- Technology used to enhance biotransformation processes-Biotransformation of some pharmaceutical compounds (Terpenoids and antibiotics)- Preparation of some steroids hormones and derivatives- Biotransformation of sterols, contaminant and pollutants, pesticides, hydrocarbons and polychlorinated biphenyl, poly-

aromatic and aromatic hydrocarbons- Improvement of biotransformation processes- Biotransformation of immobilized cells and its applications.

MICR 383: Biodegradation **1Cr.Hr. (L1+P 0)**

Prerequisite: MICR 221, MICR 231

The roles of microorganisms related to biodegradation of environmental contaminated substances. Biodegradable polymers decompose in natural aerobic (composting) and anaerobic (landfill) environments. Biodegradation of these polymers can be achieved by enabling microorganisms in the environment to metabolize the molecular structure of the product to produce safe and clean byproducts.

MICR 384: Antibiotics **2Cr.Hr. (L1+P 2)**

Prerequisite: MICR 221, MICR 231.

General properties of anti-microbial agents. Mechanism of action of antibiotics. Classes of antibiotics. Resistance to antibiotics, Types of bacterial resistance; How overcoming antibiotic resistance? Food and drug interactions with antibiotics; Betalactam and Non-betalactam antibiotics. Inhibitors of cell wall synthesis: **Penicillin and Cephalosporins**: Mechanism of action; Microbiological spectrum, Adverse reactions. Inhibitors of protein synthesis: **Macrolides and tetracyclines**: Kinetics, Microbiological spectrum, Adverse reactions. Inhibitors of nucleic acid synthesis or function: **Fluoroquinolones**: Kinetics, Microbiological spectrum, Adverse reactions. Antifungal compounds; Progress and Importance, Uses, Classes, Side effects.

MICR 386: Control of Microorganisms **2 Cr.Hr. (L1+P2)**

Prerequisites: (-)

Intrinsic and extrinsic factors and their relationship to microbial growth; Factors influencing antimicrobial activity; Mode of action of antimicrobial agents; Physical control of microorganisms (e.g.; temperature and radiation); Chemical control of microorganisms (e.g.; antiseptics and disinfectants); Antibiotic and other chemotherapeutic agents; Mechanical control of microorganisms (e.g.; Filtration); Biological control of microorganisms; Control of the disease process; Monitoring the fate of biocontrol bacteria and fungi; safety of fungal biocontrol agents.

MICR 388: Applied Microbiology **2 Cr.Hr. (L1+P2)**

Prerequisite: (MICR 101)

Fermentation basics. Fermenter systems: The main types of bioreactors; Sterilization; fermentor, air and medium sterilization; Fermentation processes: solid state fermentation, submerged cultures (batch, fed batch &continuous cultures). Range of fermentation process, microbial biomass, microbial enzyme, microbial metabolites, and transformation processes. Bioseparation processes: The selection of the appropriate purification procedure. Various stages of wastewater treatment: Primary, secondary and tertiary treatment. Microbial spoilage of food products including cereals, fruits, vegetables, meat, fish, and dairy products. Food safety and preservation.

Courses Contents of the Geology Department

GEOL 301: Structural Geology **3 Cr. Hr. (L2+P3)**

Prerequisite: (GEOL 101)

Determining top and bottom of rocks, Stress and strain and types of stress. Factors affecting the mechanical properties of rocks. Folds description, representation and mechanisms.

Cleavage, foliation, and lineation. Brittle deformation and principal stress axes. Joints types and representation. Faults types and identification. Normal faults, rifts, and growth faults. Thrusts and thrust systems. Strike-slip faults and wrenching. Salt diapirs. Importance of structures in mineral deposits, oil and gas traps, groundwater, and engineering projects. Transfer zones and fault terminations.

GEOL 302: Geomorphology **3 Cr. Hr. (L2+P3)**
Prerequisite: (GEOL 101)
Glimpse on historical background, Geomorphological processes, Physical processes, Chemical processes, Mass movements. Fluvial geomorphology, Karst processes and landforms, Arid region geomorphology, coastal processes and landforms. Desertification: definition and management. Geomorphological mapping.

GEOL 303: Metamorphic Petrology **3 Cr.Hr. (L2+P3)**
Prerequisite: (GEOL 201)
Introduction, diagenesis and metamorphism, agents of metamorphism, mineral paragenesis, Types of metamorphism, Textures of metamorphic rocks, Mineral composition of metamorphic rocks, Progressive regional metamorphism and metamorphic zones, Metamorphic facies and facies series, Metamorphism of different rock types: Regionally, thermally and dynamically metamorphosed igneous and sedimentary rocks. Migmatites (contact and regional migmatites), Mineral deposits associated with metamorphic rocks. Plate tectonics and metamorphism.

GEOL 304: Geochemistry **2 Cr.Hr. (L1+P2)**
Prerequisite: (GEOL 202)
Introduction, abundance and distribution of elements. Geochemical classification of elements. Crystal chemistry, magmatism and igneous rocks: crystallization of magma (phase rule, physicochemical changes during calc-alkaline and theolitic magmas crystallization, effect of pressure on basaltic magma crystallization), Petrochemical calculations, trace elements in magmatic evolution. Sedimentary rocks: sedimentation as a geochemical process, redox potential, geochemical fences, soil geochemistry, trace elements in sedimentary rocks. Metamorphic rocks: equilibrium relations of metamorphism, trace elements in metamorphic rocks, metamorphic reactions.

GEOL 305: Stratigraphy **3 Cr. Hr. (L2+P3)**
Prerequisite: (GEOL203)
Stratigraphic principles. Lithostratigraphy: classification and relationships, sedimentary facies, transgressions & regressions, sea-level changes, correlation procedures. Depositional sequences, internal relationships, types of sequences and sequence boundaries, parasequences and parasequence sets, sedimentary cycles. Magnetostratigraphy. Biostratigraphy, biostratigraphic units, bases for biozonation, biocorrelation. Chronostratigraphy and Geochronometry, Chronostratigraphic Units, Geochronologic Units, Geochronometric units, the Geologic Time Scale, Chronocorrelation. The Phanerozoic Systems: subdivisions, stratotypes, facies characteristics, faunal and floral characteristics, tectonic events.

GEOL 306: Subsurface Geology **2 Cr. Hr. (L1+P2)**
Prerequisite: (GEOL 301)
Basic concepts of subsurface geology. Overview of subsurface geological and geophysical tools, subsurface mapping. Faults in subsurface. Subsurface maps. Subsurface cross

sections. Integration and interpretation of all subsurface geological data. Creation of subsurface 2D and 3D geological models.

GEOL 307: Isotope Geology 3 Cr.Hr. (L2+P3)
Prerequisite: (GEOL202)
Introduction, Classification of isotopes. Theory and law of radioactive decay. Age dating of igneous and metamorphic rocks. Important examples of dating methods (Rb-Sr, Sm-Nd, K-Ar, U-Pb), blocking temperature. Uranium-series disequilibrium and its applications. Application of radioactive disequilibrium in dating of rocks and minerals. Stable isotopes, isotopic fractionation and its applications. Study of oxygen, hydrogen, sulfur and carbon isotopes. Marine O and H records as tracers of global events: glacial-interglacial climate change.

GEOL 308: Field Geology and Geological Mapping 3 Cr.Hr. (L2+P3)
Prerequisite: (GEOL 301)
Nature of field work-identification of topographic and geomorphic features in the field. Field relations of sedimentary, igneous and metamorphic rocks. Measurement of distance, angles, and directions. Measurements of differences in elevation. Study of the surveying instruments. Details on the use of the Plane table Alidade and Stedia Rode. Methods of measuring stratigraphic sections. Aerospace images and geologic mapping. Geologic report.

GEOL 309: Vertebrate Paleontology 3 Cr. Hr. (L2+P3)
Prerequisite: (GEOL 203)
Classification of chordates; origin of chordates; general features of vertebrates. Jawless fishes; general features of ostracoderms. The origin of jaws; general features of sharks; history of placoderms. Actinopterygians and crossopterygians; the Coelacanth. The fish-amphibian transition; general features of amphibians; land-based tetrapods: the reptiles. Marine reptiles. General features of birds; skeletal parts; origin of flight. General features of mammals; Mesozoic mammals; beck to the sea: the whales. Life of earliest chordates; the success of bony fishes; the reptilian egg; adaptive radiation in Cenozoic mammals; Hominids and the ascent of *Homo sapiens*.

GEOL 310: Remote Sensing 2 Cr.Hr. (L1+P2)
Prerequisite: (GEOL 101)
History and fundamentals of remote sensing (RS). Energy, sensor, platforms, aerial and space platforms. Electro-magnetic radiation (EMR) and spectrum. EMR interaction with atmosphere and earth surface, rocks water, and soil. Imaging spectrometry and spectral characteristics. Satellites classification and sensors. Resolution and Multi Spectral Scanning. Current Satellites, Radar, Speckle, Back Scattering, Side Looking Airborne Radar, Synthetic Aperture Radar, Radiometer. Geometrical characteristics and Sonar remote sensing systems. Image processing analysis. Integration and applications of RS and GIS.

GEOL 312: Plate Tectonics 3 Cr.Hr. (L2+P2)
Prerequisite: (GEOL 202)
Historical perspective. Internal structure of the Earth. Continental drift theory. theories and discoveries preceding plate tectonic theory. Plate tectonics concepts and boundaries. Divergent plate boundary. Sear floor spreading. Convergent plate boundary. Subduction zones. Transform and transcurrent faults. Continental rifts, continental margins and

sedimentary basins. Mountain ranges. The mechanism of plate tectonics. Implications of plate tectonics in sedimentary basins, ores and mineralization, and earthquakes.

GEOL 313: General Geomorphology 2Cr.Hr. (L1+P2)
Prerequisite: (GEOL 101)
Glimpse on historical background, Geomorphological processes, Physical processes, Chemical processes, Mass movements, Fluvial geomorphology, Karst topography, Arid region geomorphology, Geomorphological mapping.

GEOL 314: Structural Framework of Egypt 3 Cr.Hr. (L2+P2)
Prerequisite: (GEOL 301)
Pan-African orogeny and Precambrian structures in the Eastern Desert and south Sinai. Paleozoic deformations. Mesozoic rifting. Late Cretaceous folding and basin inversion (Syrian Arc deformation) with examples from the outcrop (north Sinai) and the subsurface (northern Western Desert). Tertiary rifting in the Suez rift and Red Sea. Seafloor spreading in the Red Sea. Wrench structures along the Dead Sea transform.

GEOL 315: Marine Geology 3 Cr.Hr. (L2+P3)
Prerequisite: (GEOL 204)
Introduction, Origin and Morphology of Ocean Basins, Origin and Morphology of Ocean Margins, Oceans Basin Tectonics, Sources and Composition of Marine Sediments, Seawater Chemistry, Animals of the Pelagic and Benthic Environments, Biochemical Processes in Seawater, Effects of Waves and Currents, Sea Level Processes and Effects of Sea Level Change, Imprint of Climatic Zonation on Marine Sediments, Deep-Sea Sediments, Paleoceanography.

GEOL 316: Sequence Stratigraphy 3 Cr. Hr. (L2+P2)
Prerequisite: (GEOL 305)
Introduction: an overview, historical development, sequence stratigraphic approach, time significance. Accommodation and shoreline shifts. Milankovic theory, sedimentary cycles, global sea-level curve. Methods of sequence stratigraphic analysis. Types of stratigraphic sequences. Systems tracts. Parasequences and parasequence sets. Sequence models. Time attributes of different stratigraphic surfaces: Reference curve, methods of definition of stratigraphic surfaces. Applications of sequence stratigraphy in hydrocarbon exploration.

GEOL 317: Selected Topics in Paleoecology 2 Cr. Hr. (L1+P2)
Prerequisite: (GEOL 215)
Definition of ecology and paleoecology, fundamental ecological principles, the principle of uniformitarianism, the nature and classification of environments, the marine ecosystem, mode of life and nutrition, functional morphology, fossil orientation, evidence of biologic activity, associated sediments, lateral variation, abundance and diversity, changes in habits and habitats, interaction between species, spatial distribution of populations, limiting factors, fossil communities, post-mortem information loss, taphonomy (biostratinomy and fossil diagensis).

GEOL 318: Petroleum Geology and Geochemistry 3 Cr.Hr. (L2+P3)
Prerequisite: (GEOL 204)
Introduction and origin of hydrocarbon. Organic matter transformation: Factors influencing organic richness, examples of rich sediments, stages of hydrocarbon generation, Kerogen, Bitumen, Biomarkers. Analytical techniques: Source rock evaluation, examples of source

GEOL 326: Principles of Stratigraphy **2 Cr. Hr. (L1+P2)**
Prerequisite: (GEOL 215)
Stratigraphic principles. Lithostratigraphy: lithostratigraphic classification and relationships, sedimentary facies, transgressions and regressions, sea-level changes, correlation procedures. Depositional sequences, internal relationships, types of sequences and sequence boundaries, parasequences and parasequence sets, sedimentary cycles. Magnetostratigraphy. Biostratigraphy: biostratigraphic units, bases for biozonation, biocorrelation. Chronostratigraphy and Geochronometry, Chronostratigraphic Units, Geochronologic Units, Geochronometric Units and radiometric dating, the Geologic Time Scale, Chronocorrelation.

GEOL 328: Geologic Setting of Egypt **3 Cr.Hr. (L2+P2)**
Prerequisite: (GEOL 301)
Pan-African orogeny and Precambrian structures in the Eastern Desert and south Sinai. Paleozoic deformations.Mesozoic rifting. Late Cretaceous folding and basin inversion (Syrian Arc deformation) with examples from outcrops (north Sinai) and the subsurface (northern Western Desert). Tertiary rifting in the Suez rift and Red Sea.Seafloor spreading in the Red Sea. Wrench structures along the Dead Sea transform.

Courses Contents of the Geophysics Department

GEOP 301: Principles of Radiometric Methods **2 Cr. Hr. (L1+P2)**
Prerequisite: (*GEOP 102*)
Concepts of radioactivity of rocks, radioactive decay series, abundance of radioelements in crystal rocks. Radiometric instrumentations, selecting surveying parameters, data processing and presentation of gamma ray survey. Methods of interpretation and statistical treatment to such data and correlation between them. The relation of radioelements abundances and their ratios with mineralizing processes and in general the role of radiometric anomalies in radioelements exploration. Application of gamma ray spectrometry in mineral exploration, directly to radioelements and indirectly to non-radioelements minerals. Application of gamma ray spectrometry in environmental purposes and hydrocarbon exploration.

GEOP 302: Principles of Environmental Geophysics **2 Cr. Hr. (L1+P2)**
Prerequisite: (-)
Definition of environmental sciences, target definitions, target physical parameters. Geophysical methods applied to solve environmental problems. Geophysical methods applied to solve environmental problems related to groundwater and soil contamination problems. Geophysical methods applied to solve environmental problems related to nature of subsurface rocks, landslides, permafrost, and seismic hazard potential. Geophysical methods applied to solve environmental problems related to archeological remains, tunnels and caves. Geophysical methods applied to solve environmental problems related to selection of suitable sites for chemical and nuclear waste disposal.

GEOP 303: Paleomagnetism **3 Cr. Hr. (L2+P2)**
Prerequisite: (*GEOP 104*)
Introduction to geomagnetism: Basic definitions, origin and nature of the geomagnetic field. Rock magnetism. Natural remnant magnetization (NRM). Field sampling and laboratory measurements. Statistical analysis and paleomagnetic poles. Geochronology, paleogeography

and global tectonics: magnetic reversals and development of magnetostratigrphy, apparent polar wander paths (APWP) and paleomagnetic dating- Case studies. Paleomagnetism in Egypt: History, case studies, facts about paleomagnetism in Egypt, recent technical developments and trends, and prognosis

GEOP 304: Radiometric Methods **2 Cr. Hr. (L1+P2)**

Prerequisite: (-)

Concepts of radioactivity of rocks, radioactive decay series, abundance of radioelements in crystal rocks. Radiometric instrumentations, selecting surveying parameters, data processing and presentation of gamma ray survey. Methods of interpretation of radiometric maps and profiles (qualitative and quantitative) such as statistical treatment to such data and correlation between them. The relation of radioelements abundances and their ratios with mineralizing processes and in general the role of radiometric anomalies in radioelements exploration. Application of gamma ray spectrometry in mineral exploration, directly to radioelements and indirectly to non-radioelements minerals. Application of gamma ray spectrometry in environmental purposes and hydrocarbon exploration.

GEOP 305: Petroleum Reservoir Evaluation **3 Cr. Hr. (L2+P2)**

Prerequisite: (*GEOP 203*)

Introduction & Definition. Determination of the needed parameters used in formation evaluation such as temperatures FT, mud properties Rm, Rmf, Rmc, and formation properties Rw either graphically or analytically. Evaluation of the types of shale distribution in reservoir rocks. Determination of formation porosities. Correction of environmental effects of porosity tools. Estimation of total and effective porosities either analytically or graphically of clean and shaly rocks. Determination of fluid saturations. Water saturations (Sw and Sxo). Determination of lithologic types and contents.

GEOP 306: Well Logging-1 **3 Cr. Hr. (L2+P2)**

Prerequisite: (*GEOP 203*)

Introduction and Definition. Principles and applications of electric logs used for definition of permeable zones and shale content; SP, GRL and CL. Principles and applications of logging tools; Density, Sonic and Neutron and Resistivity logs; Conventional, logs, Focused current electric logs, Induction logs Micro logging devices. Principles and applications of production monitoring logs; TDT. Logging interpretations of clean reservoir rocks; Porosity types, formation water resistivity.

GEOP 307: Mechanical Properties of Rocks **3 Cr. Hr. (L2+P2)**

Prerequisite: (-)

Introduction and Definitions. Compressive strength measurements and its relation to other rock properties. Rheological properties of rocks. Acoustic properties of rocks. Radioactive properties of rocks. Geomechanical properties of Rocks (Fundamentals, Correlation between static and dynamic properties of reservoir rocks, strength properties). Thermal properties of reservoir rocks (Thermal properties of rock forming minerals, thermal properties of reservoir rocks, applications). Relationship between some petrophysical properties and constructing petrophysical models.

GEOP 308: Wells Drilling **3 Cr. Hr. (L2+P2)**

Prerequisite: (-)

Introduction and Definitions. Importance and applications of well logs used for prospecting and exploration of oil water and ore mineral. Drilling of well, rig types, composition of drilling rig. Drilling mud. Functions of drilling muds. Required properties of drilling muds. Types of

drilling muds. Different problems related to drilling muds. Completion of drilled well. Casing program. Cement program. Coring program. Classification of well log measurements, factors affect on log measurements, composition of logging tool, presentation of well logs and parameter measured from each log.

GEOP 309: Engineering Geophysics **3 Cr. Hr. (L2+P2)**
Prerequisite: (*GEOP 205*)
Introduction and definitions of Engineering Geophysics, shallow versus deep geophysical applications. Engineering-geological characterizations. Shallow refraction seismic and high resolution reflection seismic as sole methods of exploration for bedrock topography, depth estimation, subsurface structures and geo-technical parameters of foundation layer. Geoacoustic methods for detection of slope movements, seismic tomography. Electric and electromagnetic methods, as indicators of groundwater. Micro-gravity, radar in detection of voids, caves, tunnels and buried. Magnetic, electromagnetic and radar as tools for detecting mineral deposits, buried metal objects.

GEOP 310: Electro-magnetic Methods **3 Cr. Hr. (L2+P2)**
Prerequisite: (*GEOP 202*)
Electromagnetic (EM) Elementary theory. Classification of EM methods according to the operating frequency ranges. Frequency-domain EM methods: Magnetotelluric (MT) family (MT, CSMT, AMT, CSAMT and AFMAG), horizontal loop electromagnetic (HLEM) family (Sundberg, Turam and moving EM sources) very low frequency (VLF–EM) family (VLF, VLF-R and RMT) and terrain conductivity (TC) meters family (EM–34, EM–31, GEM–2, etc.). Time-domain EM methods: Transient electromagnetic (TEM) family (NanoTEM and ZeroTEM) and Long–offset electromagnetic TEM (LOTEM) family. Ground penetrating radar (GPR). Inversion of EM data. Joint-inversion theory. Electromagnetic investigation.

GEOP 311: Seismic Reflection Methods **3 Cr. Hr. (L2+P2)**
Prerequisite: (*GEOP 205*)
Geometry of reflection paths, Snell's law, effect of reflector dip. Characteristics of seismic events, events other than primary reflections, diffractions, multiples, surface waves. Requirements (equipments) for land and marine surveys: Energy sources, receivers (geophones, hydrophones), cables, streamers, seismic instrumentations (recording systems), recording formats, recording techniques (analog, digital, binary), and recording channels, receiver arrays, shot-holes, field records. Reflection field methodology: 2D seismic, 3D seismic, up-hole surveys, and vertical seismic profiling (VSP). Reflection data reduction, processing and interpretation. Advanced 3D seismic interpretation.

GEOP 312: Observatory Geophysics **2 Cr. Hr. (L1+P3)**
Prerequisite: (-)
Electric and electromagnetic methods, as indicators of groundwater. Micro-gravity, radar in detection of voids, caves, tunnels and buried. Magnetic, electromagnetic and radar as tools for detecting mineral deposits, buried metal objects. Continuous measurements of stress in-situ in active fault zones, and applications in earthquake prediction. Stress evaluation in oil wells and its application in the identification of fluid interfaces and the hydro-mechanical conditions of the oil field. Continuous recording of earthquake acceleration and its impact on civil structures. Continuous recording of magnetic elements and show its impact on communication, radio wave transmission. Continuous recording of earth tides.

GEOP 313: Petroleum Reservoir Properties **2 Cr. Hr. (L1+P2)**
Prerequisite: (*GEOP 208*)

Introduction. Determination of the needed parameters used in formation evaluation. Determination of volume of shale content (Vsh). Correction and selection the weighted value of Vsh. Evaluation of the types of shale distribution in reservoir rocks. Determination of formation porosities. Correction of environmental effects of porosity tools. Estimation of total and effective porosities. Determination of fluid saturations. Water saturations. Hydrocarbon saturations for clean and shaly reservoir. Determination of lithologic types and contents. Estimation of matrix content. Determination of lithologic types by using analytical techniques through simultaneous equations.

GEOP 314: Seismic Data Processing Techniques **3 Cr. Hr. (L2+P3)**
Prerequisite: (-) **For Geology-Geophysics Program**
Seismic data formats and field acquisition standard SEGY format. Seismic data multiplexing and demultiplexing, reformatting Seismic data to internal Industry format, trace editing for noisy data (filtering, omitting, polarity reversal, notch filtering ...). Refraction and elevation statics, Noise removal techniques, (FK filters, Frequency filtering). Deconvolution (Spiking and predictive and the mathematics of the inverse filter). Velocity analysis (Constant Velocity Panels, Constant Velocity Stacks and correlation methods). Seismic migration (principles and characteristics). Data delivery in standard SEGY format.

GEOP 315: Seismic Methods **3 Cr. Hr. (L2+P3)**
Prerequisite: (*GEOP 102*)
Geometry of seismic refraction ray paths, critical incidence, Snell's law, problems to be solved by seismic refraction method. Refraction profiling on land. Refraction data reduction. Layer thicknesses determination methods. True velocity determination. Determination of fault throws. Problems and limitations of seismic refraction. Geometry of reflection paths, Snell's law, effect of reflector dip. Characteristics of seismic events. Requirements for land and marine surveys. Reflection field methodology: 2D and 3D seismic Acquisition. 3D seismic interpretation. In-line and cross-line vertical seismic sections, types of maps, horizontal slices, horizon slices, up-hole surveys, and vertical seismic profiling (VSP). Seismic stratigraphy. Advanced 3D seismic interpretation. Types of seismic attributes, types of coherence, attribute maps.

GEOP 316: Principles of Earthquake Seismology **3 Cr. Hr. (L2+P2)**
Prerequisite: (-)
Introduction - Earthquake definitions - Earthquake parameters - Propagation paths and Earthquakes classification - Recording systems - Earthquake intensity – Dynamic parameters. Frequency-magnitude relationship - First motion - Earthquake hazard assessment.

GEOP 317: Applications on Potential-field Methods **2 Cr. Hr. (L1+P2)**
Prerequisite: (-)
Potential Field Methods (Gravity-Magnetic-Electrical-Electromagnetic). Gravity Prospecting Method. Magnetic prospecting methods. Geo-electric prospecting methods. Integrated potential field methods. Case studies. Applications and case studies in economic earth's resources prospecting, exploration, production and development programs.

GEOP 318: Inversion Theory for Geophysical Data **2 Cr. Hr. (L1+P2)**
Prerequisite: (-)
Basic principles and concepts of inversion theory. Forward modeling algorithms, data and model vectors. Inverse model resolution and uncertainties. A plausible earth model. Non-linear problem in Geophysics. N-dimensional (data) and M-dimensional (model parameter) Euclidean spaces. Forward calculation, objective function and error minimization. Model update and N x M Jacobian (model resolution/sensitivity) matrix. The least-square fitting and 'Gauss-Newton'

solution. Inversion as optimization. Modeling the nearby-topography. One-dimensional (1D) and multi-dimensional (MD) earth inversions. Inversion applications for different field geophysical data sets.

GEOP 319: Fundamentals of Geodesy **2 Cr. Hr. (L1+P2)**

Prerequisite: (-)

Geodesy and plate tectonics. The function of geodesy. The motion of the earth, earth's gravity field, earth shape and size. Reference datum. Point positioning, and relative positioning. Geodynamics and geodetic measurements. Measuring the Earth deformation using the present day tools (leveling, triangulation, SLR, GPS, seismological networks and GPS networks).