كلية العلوم

FACULTY OF SCIENCE

Department of Geological sciences

GES111 Physical Geology

3 Cr. Hrs. = (*2* LCT + *1* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Physical geology is the study of the Earth system, minerals, rocks, structural geology, plate tectonics, geologic time, geological processes, and landforms. This course is designed to give a basic understanding of geology and geological techniques for both geology and non-geology majors.

GES112 Mineralogy and Minerals Optics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

This course covers topics including, Composition of the Earth crust, Definition of a mineral, Crystals and crystallographic properties of minerals, Genesis of minerals, Physical properties of minerals, Chemical properties of minerals, Crystal chemistry of minerals, Genesis, and occurrence of minerals in nature, Classification of minerals, Systematic mineralogy.

GES119 Laboratory Safety and Good Laboratory Practice

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Material safety data sheets. Good lab practices. Good manufacturing practices. Fire safety. Regulatory agencies. Safe use of lab equipment & chemicals. Using emergency equipment. Safety planning.

GES211 Sedimentation and Stratigraphy

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES111**

This course covers topics including, Introduction, Types and origin of sediments and sedimentary rocks, Types of weathering and factors control these types, Transport of sediment grains (path, loads and gravity flow), Texture and structures of sediments, Sedimentary environments, Fundamental principles of stratigraphy, Stratigraphy and facies, Stratigraphic units, Dating and correlation.

GES212 Structural Geology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES111**

This course covers topics including, Determining top and bottom of rocks, Stress and strain, Types of stress at different plate boundaries, Factors affecting the mechanical properties of rocks, Types of deformation (Folds-Cleavage, foliation, and lineation), Brittle deformation and relationship of fractures to principal stress axes, Joints, Faults and their identification, Salt diapirs, Importance of structures in quarries, mineral deposits, oil and gas traps, groundwater aquifers, and engineering projects. Reading geologic maps, Interpretation of sequence of deformation events and construction of structural cross sections, Stereographic projection, Representation of orientation data on rose, point, and contour diagrams, Construction of structure contour maps.

GES213 Geomorphology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

This course presents the concept and importance of geomorphology in geography, as the student will recognize structural and surface forms resulting from surface erosion, with learn practical aspects of geomorphologic study and training students on geomorphologic projects applied on water resources, coastal beaches and spatial changes in dry land and vegetation, as well as the impact of floods on land forms and effects of floods on human populations, as well as training students on flood modeling path to develop solutions to avoid any damages of floods.

GES214 Igneous and Metamorphic Petrology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES112**

This course covers topics including, Forms and structures of extrusive and intrusive igneous rocks, Composition and textures of igneous rocks, Crystallization of igneous minerals from silicate melts, Origin of igneous rocks, Magmatic evolution and igneous rocks diversity, Classification of igneous rocks, Igneous rock associations, Metamorphism and 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, Metamorphism of different rock types, Mineral deposits associated with metamorphic rocks, Plate tectonics and metamorphism.

GES215 Medical Geology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES111**

This course covers topics including, Basic concepts of Medical Geology, interaction between abundances of elements and isotopes and the health of humans and plants, Natural distribution and occurrence of elements, Anthropogenic sources, Uptake of elements, particularly trace elements from the food to humans, Biological response on elements, particularly trace elements, Geological aspects on the nutrient supply, Transport of elements in air with a focus on volcanic activity, radon problems and natural aerosols of dam and health effects, Environmental epidemiology with special consideration to experimental framework, Environmental medicine in relation to the natural environmental influence on human health, Risk assessment of exposure for trace elements in the environment, Relationship between the risks with exposure for trace element in our environment and other health risks.

GES216 Radioactive Mineralogy

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES112**

This course covers topics including, Definition of Radioactive Minerals-Naturally Occurring Radioactive Isotopes- Precautions for storing radioactive Minerals-Caveats on the Calculation of radioactivity in minerals, Calculation of Radioactive Activity, Radiation Dose Estimation, Radioactive Isotope Activities.

GES217 Carbonate Depositional System

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES211**

This course covers topics including, Carbonate rocks in the modern and geologic record including patterns and processes of sedimentation and digenesis as well as depositional models, Field study of modern and Pleistocene carbonate rocks and their depositional environments of the Egyptian northern coast.

GES218 Natural Disasters

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES111**

This course covers topics including, Basic understanding of geology and how it affects the human race, Analysis of threats associated with living on a dynamic planet, Focus on the origins and physical natures of hazardous geological events, taught using case studies of actual disasters, intended to convey how we can minimize our vulnerability to disasters by applying lessons learned from past earthquakes, volcanic eruptions, floods, landslides, and sinkhole collapses.

GES311 Geological Survey and Field Mapping

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES213**

This course covers topics including, Nature of field work, Identification of topographic and geomorphic features in the field, Field relations of sedimentary, igneous, and metamorphic rocks, Field relations of ore minerals, 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.

GES312 Hydrogeology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES212**

This course covers topics including, Introduction and historical review, The hydrologic cycle, climatic elements and associated balances, Subsurface zonation and origin of groundwater, Aquifers and properties, Wells and springs and hydrologic measurements, Groundwater flow systems, mathematical and graphical approaches, Hydro-chemical characteristics, Hydro-geologic functions of rocks, relationships and impacts, Review of hydro-geologic conditions of Egypt and selected countries in the Arab World and Middle East.

GES313 Subsurface Geology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES213**

This course covers topics including, 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.

GES314 Geology of Egypt

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES317**

This course covers topics including Precambrian Rocks of Egypt. Distribution of basement rocks in Egypt, Tectonic evolution of basement rocks, Classification of the basement rocks of Egypt, geosyncline versus plate tectonic model classifications, The basement rock units of Egypt,

Gneisses and migmatites, ophiolites-mélanges, metasediments, arc-metavolcanics, arc-granitoids, Dokhan volcanics, Hammamat Sediments, Felsites, Younger gabbro's, Younger granites and post-granite dykes, Mineral deposits and ornamental stones in the Basement complex, Phanerozoic plutonism and volcanicity. Phanerozoic Rocks of Egypt. Tectonic framework of Egypt, The Paleozoic surface exposures and subsurface successions in Sinai, the Eastern Desert and the Western Desert of Egypt, The Triassic at Areif El-Naga, other exposures and subsurface sections, The Jurassic exposures in Northern Sinai and the Gulf of Suez region, The distribution and stratigraphically Paleontology of the Cretaceous rocks in Egypt, The Paleocene exposures in Egypt, The Eocene rocks in Sinai, the Western Desert, the Eastern Desert and the Nile Valley of Egypt, The Oligocene facies in Egypt, The Neogene stratigraphy of Egypt, The Quaternary in Egypt, Subsurface stratigraphy of oil fields in Egypt.

GES315 Marine Geology

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **GES216**

This course covers topics including, Introduction, Origin and Morphology of Ocean Basins and 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.

GES316 Environmental Geochemistry

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

This course focuses on geochemical processes that occur at or near the surface which are of particular importance to environmental quality and therefore to humans. During the first few weeks of the course students explore some important principles that serve as the foundations of geochemistry. The next several weeks of the course explore the application of geochemical tools in sediments, soils, and waters. In the final part of the course students apply these tools to answer a question of interest as part of a course research project.

GES317 Pedology

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **GES211**

This course covers topics including, Concept of soil, factors of soil formation, introduction to soil morphology and systems of soil classification, discussion of major soil groups of world and soils of Egypt.

GES318 Forensic Geosciences

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **GES111**

This course covers topics including, Introduction to geologic, geophysical, and geochemical techniques used by forensic investigators.

GES319 Journal Club

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite *- - -*

Each meeting of the journal club will have an assigned presenter. This person will provide the instructor with the title and citation information for the paper they have chosen to present at least one week in advance of their presentation. It is expected that the audience members will have read the paper prior to each meeting. The presenter will present (using presentation software such as PowerPoint or Keynote, overheads, or a suitable alternative) the background and context of the paper, the paper itself, and interpret the implications of the paper.

GES321 General Geophysics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

A comprehensive introduction to the physical study of the Earth, concentrating on descriptive and interpretative aspects of both pure and applied geophysics, including discussion of earthquakes and seismology, gravity, geomagnetism, the thermal state of the Earth and plate tectonics.

GES322 Environmental Geophysics

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite GES321

This course covers topics including, Introduction to environmental and geotechnical geophysics, Survey of applied geophysical methods including seismic, gravity, magnetic, electrical, and electromagnetic techniques.

GES411 Engineering Geology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite GES212

This course covers topics including, Advanced soil and rock mechanics, Engineering classification of soils, Engineering classification of rocks, Site investigation techniques, In-situ tests and monitoring techniques, Mechanical properties of sedimentary, igneous, and metamorphic rocks, Rocks and soils slope stability analysis and protection measures.

GES412 Soil, Water and Air Pollution

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite GES316

This course covers topics including, Chemical principles and processes involved in the generation and movement of contaminants, sources, fate, and chemical behavior of some of the most important classes of chemical pollutants.

GES413 Isotopes Geology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite GES316

This course covers topics including, 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, Sulphur and carbon isotopes, Marine O and H records as tracers of global events: glacial-interglacial climate change.

GES414 Water Resources and Sustainability

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES312**

This course covers topics including, Fundamental concepts and theories related to the occurrence, movement, storage, quality, and sustainability of water resources, real-world issues of water resources sustainability, water risks, contamination, remediation, health, economics, and disputes; the water-energy nexus water security; and efforts to improve sustainability of water resources.

GES415 Remote Sensing and Gis Methods

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES317**

This course covers topics including, 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.

GES416 Environmental Geology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **GES316**

This course covers topics including, Introduction and definitions, Concepts of environmental geology, Geological sites and processes, Mineral resources and environmental impacts, Natural hazards, Climate change, Pollution, Waste disposal, Methods of disposal and site selections, environmental impacts of mining and the extractive industries, Medical problems related to geology and ecosystem interaction, Land evaluation and site assessment, Techniques used to monitor human-geosphere interactions: field mapping, GIS, remote sensing and geochemical techniques, Developing solutions or management plans for environmental problems.

GES417 Economic and Mining Geology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES214**

This course covers topics including, Mining Geology: Introduction, Stages of exploration program, Sampling of ore body, Indicators of ore deposits, Structural control of ores, Evaluation of ore body, Types of mining operations and mine features, Calculations of reserve estimations, Average assay, Surface and subsurface mining, Mine safety and hazards, tonnage–grade relationship, Impact of mine water and mine waste on environment. Economic Geology: Introduction, Major genetic classification of mineral deposits, Relationship between plate tectonics and ore deposition, Origin of mineral fluids, Ore deposits associating mafic and ultramafic rocks, Pegmatites and hydrothermal deposits, Porphyry ore deposits associating felsic rocks, Sedimentary ore deposits (mechanical, chemical, and biochemical), Laterites, supergene sulfides enrichment and karst deposits, Ore deposits of Egypt.

GES418 Hydrogeochemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **GES312**

This course covers topics including, Definitions and Concepts, Groundwater Aquifers, Sources and Origin, Flow Routes, Chemical Components of Ground Water, Rock interactions, Destructive and Constructive Impacts, Graphical Representations, Hydro-geochemical Classifications and Functions, Quality Assessment for Human Uses, Laboratory Exercises.

GES419 Graduation Project

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **- - -**

This project will be done in a specific topic of petroleum or mining geology.

GES428 Practical Training and Internship

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **- - -**

The course provides the student with an opportunity to gain knowledge and skills from a planned work experience in the student's chosen career field. In addition to meeting Core Learning Outcomes, jointly developed Specific Learning Outcomes are selected and evaluated by the Faculty Internship Advisor, Work-site Supervisor, and the student. Internship placements are related to the student's program of study and provide learning experiences not available in the classroom setting. Internships provide entry-level, career-related experience, and workplace competencies that employer's value when hiring new employees. Internships may also be used as an opportunity to explore career fields. Students must meet with an Internship Education Program Advisor prior to registering.

GES495 Special Topic

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Advanced topics related to field.

Department of Biological sciences

BIO119 Laboratory Safety and Good Laboratory Practice

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Material safety data sheets. Good lab practices. Good manufacturing practices. Fire safety. Regulatory agencies. Safe use of lab equipment & chemicals. Using emergency equipment. Safety planning.

BIO131 Biology I

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

The nature of living matters. Molecules – simple and complex. Bonding. Living matter. Biochemistry. The cell – animal and plant. Cell communication, membranes, and their importance. Types of energy. Redox reactions. Photosynthesis. Darwin and his theories. Natural selection and evidence for evolution.

BIO132 Developmental Biology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Introduction. Fertilization. Embryology. Early Development. Axis Formation. Sex Determination. Germline Development. Neural Development. Organ Development. Development and Disease. Environmental Influences. Evolutionary Developmental Biology.

BIO133 Evolutionary Biology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Introduction to Evolution. A Short History of Evolutionary Thought. Origins. Extinction. Evidence for Evolution. Darwinian Natural Selection. Mutation and Genetic Variation. Selection and Mutation. Genetic Drift. Sexual Selection. Mechanisms of Speciation. Origin of Life and Cells.

BIO151 Entomology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Insects and their relatives. Insect evolution. The integument. The insect's head, Eyes, and antennae. The insect thorax. The insect's abdomen and abdominal appendages. Circulation, storage, and excretion. Respiration. Nervous system. Reproduction.

BIO211 Nucleic Acid Synthesis and Metabolism

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Structure of nucleic acid. Anabolism and catabolism of nucleic acids. Formation and properties of nucleic acid chains. Role of nucleotides in cellular functions. DNA replication. DNA damage and repair mechanisms. DNA dependent RNA synthesis. mRNA structure. tRNA formation, processing, and function. rRNA formation, processing, and function. RNA folding (secondary, tertiary, and quaternary structures). RNA dependent DNA and RNA synthesis.

BIO221 Molecular Biology I

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

The molecular nature of genes. An introduction to gene function. DNA replication in prokaryotes. DNA replication in eukaryotes. Transcription in prokaryotes (Operons, Major shifts in prokaryotic transcription and DNA protein interactions). Transcription in eukaryotes (RNA polymerases and their promoters, General transcription factors, Transcription activators and Chromatin structure and transcription). Post-transcriptional events (Splicing, Capping and polyadenylation). Regulation of gene expression in prokaryotes. Regulation of gene expression in eukaryotes. Translation and translation control in prokaryotes. Translation and translation control in eukaryotes. Post-translational modifications.

BIO231 Vertebrates

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Origin of vertebrates. Evolution of vertebrates. Ecology of vertebrates. Behavior of vertebrates. Specialization of vertebrates.

BIO232 Urban Botanicals

3 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***2*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Introduction to Urban Botanicals. Using of botanicals in bio art. Succulents. Cacti. Role of flowering plants in bio art.

BIO233 Introduction to Bio Materials

3 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***2*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite

Introduction, Basic Properties of Materials, Biological Systems, Characterization of Biomaterials, Metals: Structure and Properties, Polymers, Ceramics, Paper Presentation Group Report, Natural Biomaterials, Surface Modification, Sterilization of Biomedical Implants, Cell-biomaterial Interactions, Drug Delivery Systems, Tissue Engineering Lecture 16 Clinical Applications Group Report, Paper Presentation.

BIO234 General Microbiology

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **BIO131**

Introduction. Introduction to microorganisms. Historical overview of microbiology. Introduction to microscopy. Prokaryotic and eukaryotic microorganisms. Introduction to bacteria. Cellular Biochemistry. Chemical components of cells. Bacterial cell structure. Prokaryotic Diversity. Principles of classification. Phylogeny of bacteria. Bacterial Metabolism. Principles of nutrition. Major catabolic pathways. Regulation of metabolism. Microbial Growth and Reproduction. Bacterial cell division. Growth of bacterial populations. Control of bacterial growth. Microbial Genetics. Bacterial genomes. Gene expression and regulation. Transformation and recombination. Drug resistance. Introduction to Virology. Taxonomy of viruses. Viral replication. Bacteriophage versus animal virus replication. Viruses and cancer. Viroid and prions. Immunology. Innate and acquired immunity. Humoral and cell-mediated responses. Immunization. Microbial Ecology. Populations and communities. Microbial habitats. Symbiosis. Epidemiology and Public Health. Transmission and infection. Disease

by transmission mechanisms. Disease management. Topics in Applied Microbiology. Examples: food microbiology, industrial microbiology, forensic microbiology, environmental bioremediation, genetic engineering. Laboratory Topics. Basic Techniques in Microbiology. Laboratory operations and safety. Laboratory reporting techniques. Microscopy. Bacteria: Transfer, culture, and isolation techniques. Aseptic techniques. Inoculation of media and plates. Tube transfers. Streak plate and spread plate techniques. Colony and Cellular Morphology. Agar plate colonial characteristic and agar slant growth. Individual cell characteristics (coccus, bacillus, and spirillum microscopic recognition). Differential Staining. Negative staining. Gram staining. Endospore staining. Bacterial Growth. Serial dilution. Growth rate determination (direct/plate counts). MPN (most probable number) analysis. Antibody-Antigen reactions. ELISA (enzyme-linked immunosorbent assay). Control of Microbial Growth. Disc diffusion assays. Antiseptics, disinfectants, and antibiotics. Probiotics. Practical Case Study. Characterization and identification of a microorganism using the techniques learned throughout the laboratories, as well as the information given in the theory lectures. Identification of typical species present in various samples (e.g., water, food, etc.). Other laboratory topics may also include Bacterial transformation. Bacteriophages. Macrophages and phagocytosis.

BIO235 Comparative Animal Anatomy

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite

Lecture topics: Homeostasis. Endocrine system. Nervous system. Gastrointestinal System. Hepatic system. Practical topics. Glucose Homeostasis. Thyroid function. Endocrine anatomy and histology. Neuroanatomy and histology. Neurophysiology. Gastrointestinal anatomy and histology. Gut Absorption. Accessory organs to the GIT anatomy and histology. Liver function.

BIO241 Biology II

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite ***- - -***

The Diversity of Life. Prokaryotes. Eukaryotes. Plant cell types. Plant structure, physiology, and reproduction. Animal anatomy & physiology. Tissue types. Organ systems. Chromosomes. Mitosis and Meiosis. Egg and sperm formation. Genes and environment.

BIO242 Paleobotany

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***- - -***

Origins of life, and evolution. Diversification of the Land Flora - Evolution of stem/leaf/root organography. The earliest land plants. The first leaves. The first trees. Changes in reproductive biology lead from spores to seeds and pollen. The evolution of flowering plants. The response of plants to continental rearrangements. The contributions and response of plants to changes in climate. Introduction and geological context. Fossil formation. Classification and modes of fossil preservation.

BIO311 Molecular Biology II

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **BIO221**

The molecular nature of genes. An introduction to gene function. DNA replication in prokaryotes. DNA replication in eukaryotes. Transcription in prokaryotes (Operons, Major shifts in prokaryotic transcription and DNA protein interactions). Transcription in eukaryotes (RNA

polymerases and their promoters, General transcription factors, Transcription activators and Chromatin structure and transcription). Post-transcriptional events (Splicing, Capping and polyadenylation). Regulation of gene expression in prokaryotes. Regulation of gene expression in eukaryotes. Translation and translation control in prokaryotes. Translation and translation control in eukaryotes. Post-translational modifications.

BIO312 Principles of Genetic Analysis

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

Introduction to Molecular genetics. Chromatin & Chromosomes. Genome, Transcriptome, Proteome. Genome structure, stability, and organization. Prokaryotic versus Eukaryotic Genomes. Accessing Genomes. Mapping genomes. Molecular genetics of development. Types of mutations and identification of disease genes. Epigenetics. Methods and experimental tools used in modern molecular genetics.

BIO313 Introduction to Bioinformatics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction to Bioinformatics and Biological Databases. NCBI Tools. Sequence manipulation and analysis. Sequence alignment theory and applications. Sequence alignment and matching. Multiple sequence alignment methods and algorithms. Evolution and Phylogenetic analysis. PCR primer Design. RNA Bioinformatics: secondary structure prediction. Comparative structure modelling.

BIO314 Basic Genomics

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

Assembly of sequences. Genome Annotation. Categories of functional genes. Distribution of sequence classes. Common features of genomes. Genomic features specific to individual species. Genomic features shared by bacterial genomes. Genomic features shared by eukaryotic genomes. Variation among eukaryotic genomes. Forward and reverse genetics. Large scale gene expression studies. Epigenetic modifications and their role in gene expression and regulation.

BIO315 Fundamentals of Proteomics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Protein structure. Protein purification. Mass spectrometry. Protein séquence determination. Protein synthèses. Post transnational modification. Protein targeting. Identification of phosphorylated protéines. Characterization of multi-protein complexes. Protein-protein interactions and quantitative proteomics. Proteomics and the study of diseases. Functional proteomics.

BIO316 Gene Expression Analysis

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction to qPCR analysis. Introduction to microarray analysis. oligonucleotide microarrays. Two-channel microarrays. Differential gene expression using microarrays. Experimental design. RNA-Seq. Analysis of qPCR data. Downstream analysis. Pathways. GO analysis. Genes group analysis.

BIO317 Introduction to biotechnology

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Introduction, History and scope of biotechnology, Review of DNA replication, transcription, and translation. Review of DNA replication, transcription, and translation continued, Natural and artificial mechanisms of DNA transfer. Introduction to vectors, Selectable markers, Cloning vectors, Expression vectors, Shuttle vectors, Creation of recombinant DNA molecules, Creation of genomic and cDNA libraries. Library screening, Ligation, Restriction endonuclease digestion and mapping, Gel electrophoresis, Northern blotting, Southern blotting. Polymerase Chain Reaction (PCR). DNA sequencing and sequence analysis. Production of monoclonal antibodies, Immunoblotting. DNA microarrays, Protein microarrays. Introduction to bioinformatics. Applications of biotechnology: Genetically engineered foods, Bioremediation and Medical biotechnology. Applications of biotechnology: DNA fingerprinting, Molecular diagnostics, Molecular forensics, and Transgenic organisms. Ethical issues in biotechnology and the future of biotechnology

BIO318 Bioinformatics

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Bioinformatics: What and why? Genomic sequences. Biological databases. Advanced BLAST. Sequence alignment. Gene and protein structure prediction. Genomics and Proteomics. Molecular phylogenetic. Bioinformatics tools. Linking genes and disease. Interpreting genetic variations. .Interpretation of array data

BIO319 Journal Club

2 Cr. Hrs. = (**2** LCT + **0** TUT + **0** LAB + **0** OTH) – SWL = **90** – ECTS = **4**

Prerequisite **- - -**

At each meeting of MJC will have an assigned presenter. This person will provide the instructor with the title and citation information for the paper they have chosen to present at least one week in advance of their presentation. It is expected that the audience members will have read the paper prior to each meeting. The presenter will present (using presentation software such as PowerPoint or Keynote, overheads, or a suitable alternative) the background and context of the paper, the paper itself, and interpret the implications of the paper.

BIO320 Gene therapy

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Molecular bases of gene therapy. Fundamentals of gene transfer. Viral vectors for gene therapy. Non-viral gene transfer. Targeting: Transduction targeting; Transcriptional targeting; Inducible and tissue-specific promoters. Transduction of antisense constructs; Antisense oligonucleotides; Ribozymes; Intracellular antibodies; RNA interference. Cancer gene therapy. Gene therapy targeting cancer neo angiogenesis. Immunological cancer gene therapy. Gene therapy of inherited or acquired diseases. Safety issues in preclinical and clinical gene therapy. Ethical issues concerning fetal or germinal cell gene therapy.

BIO321 Microbial biotechnology

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Introduction to microbial biotechnology. Bacterial genes, genomes, and

genetics. Manipulation of gene expression in prokaryotes. Strain isolation and screening. Direct mutagenesis and protein engineering. Industrial Application of Microorganisms. Recombinant microbial biotechnology products. Large scale production of proteins from recombinant microorganism. Production of small biological molecules. Production of biopolymers, antibodies &Vaccine. Microbial insecticides. Biotechnology regulation and ethics.

BIO322 Cellular structure & cell communication

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Molecular organization of cells. The Cytoskeleton. The cell microenvironment. Extra Cellular Matrix & Integrin's. Cell Adhesion. Cell Junctions. Cell Communication. Signal transduction. Cell-matrix signaling. Intracellular signal pathways. Second messenger pathways. Tools & methods used in cell biology.

BIO323 Biofarming

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Introduction to bio-farming. Integrated farm management systems. Organic management issues. Organic soil management. Weed management. Pest and disease management. Livestock management. Pasture. Crops. Crop nutrition. Bio-farming problems. Environmental .concerns

BIO324 Plant biotechnology

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Introduction to plant biotechnology. Organization and expression of plant genome. Plant tissue cultures. Molecular biology techniques and their application to molecular mapping, molecular markers, plant breeding and plant biotechnology. Production of plant secondary metabolites. Functional analysis and gene discovery in plant biotechnology. Regulation of gene and protein expression in plants. Molecular control of plant development. Molecular biology and electron transport in photosynthesis and respiration in plants. Transport of plant compounds. Molecular regulation of abiotic stress responses. Molecular recognition and regulation during biotic interactions.

BIO325 Advanced Microbiology

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **BIO234**

Microbiology: Science. Microscopy. Cell Structure & Taxonomy. Diversity of Microorganisms, Part 1: Acellular & Prokaryotic Microbes. Diversity of Microorganisms, Part 2: Eukaryotic Microbes. Chemical & Genetic Aspects of Microorganisms. Biochemistry: The Chemistry of Life. Microbial Physiology & Genetics. Controlling the Growth of Microorganisms. Controlling Microbial Growth in Vitro. Environmental Microbiology. Epidemiology & Public Health. Microbiology in Healthcare Facilities. Healthcare Epidemiology: Nosocomial Infections & Infection Control. Pathogenicity & Host Defense Mechanisms. Infectious Diseases. Pathogenesis of Infectious Diseases. Major Viral, Bacterial, and Fungal Diseases of Humans.

BIO326 Botanica: Imaging the Green Planet

3 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *2* OTH) – SWL = *165* – ECTS = *6*

Prerequisite

Biotech Culture. Open-Source DNA and Bioinformatics Bodies. Ornamental Biotechnology and Parergon Aesthetics. Embodying the Chimera: The Transgenic Involution. Biotechnology and Subjectivity. Life Transformation—Art Mutation. Why I Breed Plants. Art: in vivo and in vitro. Proteins. Skin Culture.

BIO331 Cellular and Developmental Genetics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Introduction to cellular and developmental genetics. Early Developmental genetics. Germline Developmental genetics. Neural Developmental genetics. Organ Developmental genetics. Development and Disease. Descent with modification. Speciation and its mechanisms. Population genetics and genetic variation. Mendelian inheritance and probability. Principles of animal development. Cell fate and differentiation.

BIO332 Evolutionary Genomics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Introduction to Evolutionary genomics. A Short History of Evolutionary Thought. Descent with modification: A Darwinian view of life. Speciation and its mechanisms. Levels of selection, sexual selection, and social evolution. Population genetics and genetic variation. Evolution at the molecular level and genome evolution. Mendelian inheritance and probability. Gene interactions, sex determination and sex-linked inheritance. Genetic linkage and gene mapping. Maternal inheritance and organelles. Genetics of complex characters and human genetics.

BIO411 Quantitative Genomics

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Introduction to Genome Biology. Introduction to Quantitation. Molecular evolution and sequence alignment. DNA Sequencing, Error, and Quality Control. Genome Assembly. Genome Annotation. Population genomics. Comparative Genomics. Genome Wide Association Studies. Inferring Function from Conservation. Transcriptomics. Epigenetics.

BIO412 Molecular Sequence Analysis

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

First generation sequencing technology. Pairwise sequence alignment. Dot plots. Human genome project and GenBank. BLAST. Multiple sequence alignment and phylogeny. Second generation sequencing technology. Third generation sequencing technology. High throughput sequencing. Gene expression: approaches and statistics. Metagenomics. Data display.

BIO413 Computational Genomics

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

DNA sequencing. Genome Assembly. Variant Calling. Sequence Alignment. BLAST. RNA-Seq. Transcriptome Analysis. Epigenomics. Regulatory Genomics. Human Population Genomics. Polymorphisms. Association Tests.

BIO414 Biological Data Analysis

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Molecular biology of genes. Gene expression. RNA-seq. RNA-seq read mapping. Differential expression analysis. mRNA isoform expression. Probability, likelihood, and inference. Regression as probabilistic inference. Inferring hidden variables. Cluster analysis. Data exploration and visualization.

BIO415 Genomic Data Manipulation

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Quantitative methods (review, for language: probability distributions, hypothesis tests parametric/nonparametric, permutation; will recur over following weeks as problems/examples). Programming (Python; problem sets based on quantitative methods). Computational methods (programming paradigms, practice, and practicalities, basic algorithmic). Bioinformatics programming (problem sets based on statistical methods, curated bioinformatics resources, NCBI, Gene Ontology, model organisms). Classical sequencing (NCBI, Ensembl, BioMart; HMMs/gene calling, binding site detection, chromatin features, comparative genomics). High-throughput sequencing (SRA/ENA, projects like 1KG and TCGA; technology/base calling, assembly, primers/libraries/multiplexing). Transcriptional assays (RNA-seq and microarrays: GEO, Array Express, MeV, Gene-Pattern; matrix processing/decomposition, similarity/distance measures, meta-analysis/normalization). Structure (PDB, SCOP/CATH, Pfam, SMART, Prosite, PRIDE; template/structure matching and domain prediction). Proteomics and metabolomics (Peptide Atlas, GPMPD; mass spec, peptides and fragment signatures, modification networks, brief FBA). Physical and genetic interactions (Bio-GRID, Int-Act, MINT, HPRD, etc.; network motifs, clustering). Network/systems biology). High-throughput sequencing/metagenomics).

BIO416 Computational Molecular Biology

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

The Central Dogma: Some Algorithms Introduction. Regulatory Motifs. Sequence Alignments. Sequencing Genes. Sequencing Proteins. BLAST. Microarrays. Phylogeny. Clustering. Gene Annotation. Evolution. Haplotype Mapping.

BIO417 Statistical Learning in Bioinformatics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Parameters. Estimating & Reliability. Normal Curve & Reliability. Tests of Significance. sampling from single population. Group comparison t-test. Contingency tables. Chi-square test. Analysis of variance. Multiple range analysis. Regression Analysis. Correlation Analysis.

BIO418 Molecular genetics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Introduction to Molecular genetics. Chromatin & Chromosomes. Genome, Transcriptome, Proteome. Genome structure, stability, and organization. Prokaryotic Genomes. Eukaryotic Genomes. Accessing Genomes. Mapping genomes. Molecular genetics of development. Types of mutations and identification of disease genes. Epigenetics. Methods and experimental tools used in modern molecular genetics.

BIO419 Graduation Project

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

Literature survey. Data collection. Finding a research question. Establishing the first prototype.

BIO420 Genetic engineering

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

DNA amplification and sequencing. Vector system, Restriction enzymes and ligation. Hybridization (southern blot, northern blot, and western blot). Transposon mutagenesis. Genetic engineering of microbes. Genetic engineering of plants. Genetic engineering of animals. Transgenic animals. Bioinformatics. Molecular diagnostics. Nucleic acids as therapeutic agents. .Molecular Vaccines

BIO421 Biological Databases

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction to biological databases. Information retrieval. Sequence databases. BLAST. Mapping databases. Perl. Protein and RNA databases. Heterogeneity in databases. Data complexity of biological data. Provenance issues. Evidence issues. Correctness issues.

BIO422 Genomic Regulation

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Organelle genomes, evolution, composition, regulation, and maintenance. DNA replication in prokaryotes and eukaryotes. Gene regulation in prokaryotes. Promoter architecture. Signaling by nutrients and stress in prokaryotes. Roles of RNA in prokaryotic gene regulation. Gene regulation in eukaryotes. Sequence-specific transcription factors families. Mechanisms of transcriptional stimulation – coactivators, repressors, and chromatin remodeling. Signaling to the nucleus; tissue-specific and developmental gene regulation. The co-transcriptional regulation of mRNA processing. The mechanism and control of eukaryotic protein synthesis.

BIO423 Biological Data Structures

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction to data structures and algorithms. The role of algorithms in the problem-solving process. Divide and conquer problem-solving strategies. Java collections framework and Array based lists. Computational time complexity. Computational space complexity. Introduction to sorting algorithms, insertion sort, bubble sort. Trees, tree traversal, tree implementation strategies. Introduction to graphs. Graph algorithms and implementation strategies. Strategies for choosing and implementing the right data structure and algorithm. Comparison and analysis of existing resources.

BIO424 Dynamics of Quantitative Biology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Particles Dynamics in Two and Three Dimensions (Constrained motion), Motion of a System of Particles (Linear Momentum of a System of Particles), Angular Momentum, Composition of Angular Velocities, Moving Axes, Orthogonal Transformations, Instantaneous Axis of Rotation, and Instantaneous Center of rotation.

BIO425 Molecular immunology

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Cells of the immune system. Antibodies and antigens. Innate Immunity & Cell mediated immunity. Antigen receptors. B lymphocyte & T lymphocyte development. Antigen Presentation. Asthma and Allergy. Leukemias and Lymphomas. Transplantation Immunology. Tumor Immunology. Autoimmune diseases. Immunodeficiency Disorders.

BIO426 Stem cell biology

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Basics of stem cell biology. Stem cell epigenetics. Embryonic Stem (ES) cells. Induced Pluripotent Stem (IPS) Cells. Control of ES and IPS cell differentiation. Mesenchymal Stem Cells. Hematopoietic stem cells. Tissue-specific stem cells. Cancer stem cells. microRNAs and stem cell regulation. Clinical applications of stem cells. Ethical considerations.

BIO427 Computational biochemistry

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Biochemical databases. Principles of sequence alignment. Analyzing DNA Sequences. Molecular mechanics and Molecular Dynamics. Protein folding recognition. Predicting secondary structure of proteins. Predicting 3D structure of proteins. Ligand docking. Ligand design. Analysis of ligand-receptor interactions. BLAST.

BIO428 Practical Training and Internship

4 Cr. Hrs. = (**2** LCT + **0** TUT + **4** LAB + **0** OTH) – SWL = **210** – ECTS = **8**

Prerequisite **- - -**

The course provides the student with an opportunity to gain knowledge and skills from a planned work experience in the student's chosen career field. In addition to meeting Core Learning Outcomes, jointly developed Specific Learning Outcomes are selected and evaluated by the Faculty Internship Advisor, Work-site Supervisor, and the student. Internship placements are related to the student's program of study and provide learning experiences not available in the classroom setting. Internships provide entry-level, career-related experience, and workplace competencies that employer's value when hiring new employees. Internships may also be used as an opportunity to explore career fields. Students must meet with an Internship Education Program Advisor prior to registering.

BIO429 Nano-Biotechnology

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Nanomaterial in biotechnology: nanoparticles, quantum dots, nanotubes, and nanowires. Production of various types of nanostructured materials with usage and potential within biotechnology. Using biomaterials and biomolecules as bases for inorganic structures. Introduction to surface physics and biomaterials. Methods for derivatization and characterization of surfaces and other carrying structures. Theory and methods for studies of the interaction with surfaces and fibers of biomolecules. Applications within bio-separation, diagnostics, drug delivery and bio-implants. Theory for how lipid/polymer nanoparticles can be utilized as model membranes and for

formulation/administration of drugs. Molecular prints of biomolecules. Production and applications of inorganic replicas of biological materials. Enzyme reactors based on nanostructured materials. Nano-biotechnological applications in health and disease.

BIO430 Tissue engineering

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Overview of tissue engineering. Tissue / organ structure and function. Tissue engineering strategies. Tissue engineering design. Cells as design elements. Stem and progenitor cell technologies. Cell- and soluble factor-based signals as design elements. Extracellular matrix as a critical design element. Tissue development, repair, and regeneration. Tissue transplantation. Cell and tissue mechanics. Molecular delivery and transport.

BIO431 Recombinant DNA technology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Isolation of total genomic DNA. Meaning of recombinant DNA technology. Restriction and ligation of DNA molecules. Molecular cloning. Strategies of bacterial transformation. cDNA libraries. Cell competency. Screening libraries. Electrophoresis and hybridization techniques. Model organisms. Gene expression vector systems. In vitro mutagenesis.

BIO432 Industrial biotechnology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Microbes and enzymes of industrial importance. Different types of bioreactors and bioreactor design. Microbial growth, substrate degradation and product formation kinetics. Instrumentation, Sterilization of air, media, and reactor. Pharmaceuticals and Fine Chemicals. Glycoscience and Bio-therapeutics. High fructose corn syrup, Cheese making, and single cell production. Vaccines production and metal leaching. Bioenergy. Gaseous fuels: Bio-hydrogen, Bio-methane, and Microbial fuel cell. Liquid fuels: Bioethanol, Biodiesel and Bio-butanol. Aerobic and Anaerobic wastewater treatment processes.

BIO433 Cell culture principles and techniques

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Cell culture equipment and safety. Sterile and aseptic technique. Biology of the culture cell. Cell culture media. Cell differentiation. Primary cultures. Feeding cells. Sub-culturing cells. Cell counting. Cryopreservation. Cytotoxicity assays. Tissue culture applications.

BIO434 Biotechnological applications in food industry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

What is the difference between food technology and food biotechnology? How biotechnology techniques relate to food? Recombinant proteins in food. Plant biotechnology in foods. Animal biotechnology in foods. Microbial biotechnology. Diagnostic systems in foods. Cell culture and food (brewing, dairy biotechnology, food additives). Cell culture and foods (microbial products used in food). Industrial cell culture. Ethics and safety of food biotechnology products. Regulations of food biotechnology.

BIO435 Animal biotechnology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Preservation and maintenance of animal cell lines. Gene transfer into animal cells. Transgenic animals and gene knockouts. Transgenic animals in agriculture and nutritional science. Gene editing. Stem cell therapies. Vaccine technology. Reproductive technologies. Reproductive cloning. DNA technologies. Bioinformatics. Challenges facing the various animal industries and the potential biotechnology solutions to these problems.

BIO436 Transgenics

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Introduction to genetically modified organisms. Transgenes. Transgenic animals. Transgenic plants. DNA Microinjection. RNA Microinjection. Embryonic stem cell transfer. Micromanipulation techniques. Generating transgenic mice. Transgenic animal technology. Transgenic applications. Transgenic legalities.

BIO437 Plant-Animal Interactions

3 Cr. Hrs. = (*1* LCT + *0* TUT + *3* LAB + *1* OTH) – SWL = *165* – ECTS = *6*

Prerequisite

course introduction. Evolution, Natural Selection, Species Interactions. The history of plant-animal interactions. Antagonisms: plant-insect interactions. Antagonisms: mammalian herbivory. Antagonisms: granivory. Mutualism: Pollination by animals. Refining mini research project. Mutualism: seed dispersal by vertebrates. Sharpening mini research project. Ant-plant interactions. Students' presentation: mini research project (Topics students' presentation: mini research project (Topics students' presentation: mini research

BIO495 Special Topic

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

Advanced topics related to field.

Department of Environmental sciences

ENV111 Environmental Biology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Introduction to Environmental Science. Sustainability. Population Ecology. Community Relationships and Evolution. Investigating Biodiversity. Human Population Dynamics. Sustainable Communities. Agriculture and the Environment. Global Climate Change. Waste and Recycling. Non-renewable Energy Sources. Biofuels.

ENV112 Environmental Ethics

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite **- - -**

How should human beings relate to the natural world? Do we have moral obligations toward nonhuman animals and other parts of nature? And what do we owe to other human beings, including future generations, with respect to the environment? This course will examine such questions in light of some of our current ethical theories: considering what those theories suggest regarding the extent and nature of our environmental obligations; and also, whether reflection on such obligations can prove informative about the adequacy of our ethical theories.

ENV113 Energy and Environmental Technology

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite **- - -**

Classification of Energy. Applications of Solar Energy. Introduction to Solar Photovoltaics. Bio Energy Sources. Wind Energy. Small Hydro Power Systems. Ocean and Geothermal Energy. Contemporary issues.

ENV211 Principles of Ecology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Ecology and the ecosystem concepts. Evolution and classification of earth's biodiversity. Biochemical processes in living organisms. Ecosystem ecology and biogeochemical cycles. Climate and terrestrial biomes. Aquatic ecosystems and life zones. Soil environment; formation and composition. Organismal and population ecology. Community ecology.

ENV311 Environmental biotechnology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Basic Microbiology and Microbial Growth. Metabolism and Bioenergetics. Microbial Diversity. Microbial Ecology. Microbial Molecular Biology. Principles of Genetic Engineering. Environmental genomics. Waste management & recycling. Bioremediation & Phytoremediation. Biosensor & Biofilm. Microbial fuel cell.

ENV312 Hazardous Waste Management

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***0*** LAB) - SWL = 1***50*** – ECTS =***5***

Prerequisite: ***PHS221***

This course is a comprehensive and historical overview of hazardous waste management. Topics investigated include a detailed investigation into solid waste generation and collection, as well as evaluation of strategies implemented to deal with waste, including recycling, recovery landfilling, and incineration.

ENV313 Geographic Information Systems and Spatial Analysis

3 Cr. Hrs. (***2*** LCT + ***0*** TUT + ***2*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: ***PHS325***

Building on Human Geography, this course covers the conceptual foundations of spatial analysis in public health and will highlight spatial data manipulation and visualization using GIS software. This course will have an intensive lab component and will use data in generating maps and data and communicating this data to a general audience.

ENV314 Enviromental Field Study

2Cr. Hrs. = (***1***LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***5***

Prerequisite **- - -**

General sampling Design. Descriptive statistics. Learning to use Excel for data entry and analysis, sampling design field trip. Sampling design and data analysis. Sampling spatial pattern analysis. Estimating the abundance of mobile organisms. Ecological monographs Species Diversity analysis. Interspecific association analysis. Habitat Choice.

ENV495 Special Topic

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***1*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Advanced topics related to field.

Department of Chemistry

CHE111 Organic Chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Chemical bonds, Lewis structures, formal charge, functional groups. Conformations of molecules. Physical properties (melting, boiling, solubility) in relation to structure. Stereochemistry, stereo-chemical concepts. Acids and bases, pKa, the relation between structure and acid/base strength. Alkenes, alkynes conjugated systems, arenas, aromaticity, absorption of light. Electrophiles, nucleophiles. Addition, substitution, and elimination reactions. Reactions classifications (SN1, SN2, E1, E. Reactions of alcohols, amines, ethers, epoxides. Carboxylic acids and derivatives (esters, amides) and their reactions. Reactions of aldehydes and ketones. Radicals and reactions involving radicals. Reactions of arenes. Carbohydrates, amino acids, peptides, proteins, lipids. Bulk polymers, addition polymers, condensation polymers.

CHE119 Laboratory Safety and Good Laboratory Practice

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Storage and transportation of chemicals, Risk management principles, Risk assessment techniques (HAZOP, HAZON, Fault Tree Analysis, Consequence Analysis), Onsite and offsite. emergency management, Human error Analysis and Accident Analysis.

CHE141 Physical Chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

This is a course in basic Physical Chemistry, with emphasis on elementary thermodynamics and chemical kinetics. Gases, ideal and otherwise: equations of state. Thermodynamics: temperature, system, surroundings, types of processes and reversibility. First Law: internal energy, work, heat, sign conventions. State functions vs. path-dependent variables. Heat capacity at constant volume. Equipartition principle: extensions to polyatomic molecules. Enthalpy: heat capacity at constant pressure. The Joule and Joule-Thomson experiments. The Carnot heat engine. Second Law: entropy, spontaneity. Gibbs and Helmholtz free energies: chemical potential. The approach to equilibrium: phase changes, chemical reactions. Reaction kinetics: rate laws. Measurement of reaction rates. Integration of rate laws. Determination of rate laws. Rate laws and equilibrium constants for elementary reactions. Temperature dependence of rate constants. Reaction mechanisms. Chain reactions and free-radical polymerization. Catalysis. Enzyme catalysis.

CHE142 Engineering Chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Topics include Modelling Concepts and Tools. Fluid Flow, Thermodynamics and Heat Transfer. Chemical Engineering Design and

Professional Skills. Properties and Applications of Materials. Chemistry for Engineers. Electrical, Electronic and Computer Systems. Chemical and Biochemical Processes. Other Engineering Modules or Modules Outside Main Discipline. Introduction to Energy Engineering.

CHE143 Environmental Chemistry for Public Health

2 Cr. Hrs. = (*2* LCT + *0* TUT + 1 LAB) - SWL = *105* – ECTS =*4*

Prerequisite: None

This course introduces students to environmental chemistry, the study of the distribution and interactions of matter (chemicals) in the environment, both outdoors and indoors. This is a chemistry course with a holistic/systems outlook, focusing on how chemistry can help understand contemporary environmental issues, and can offer solutions to these issues.

CHE211 Advanced Organic Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Advanced Organic Chemistry will be focused on the understanding of structure, reactivity, and underlying mechanisms of organic chemistry. The basic mechanisms of organic chemistry underlie the function of biopolymers, drugs, and manmade “smart” materials. A mechanism-focused curriculum will be a convincing demonstration of the pervasiveness and interdisciplinary nature of modern organic chemistry. This course shall provide the students with an understanding of the reactivity of organic and organometallic species that goes beyond arrow-pushing formalism.

CHE212 Applied Chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Fundamentals (Chemical Reactions, Stoichiometry, Reaction Yields, Thermochemistry Equilibrium, Equilibrium Constants, LeChatlier’s Principle, Kinetics Rate Expressions, Temperature Effects, Catalysis. Industrial Considerations [Reaction Evaluation (Selection, Economic Feasibility, Thermodynamic Feasibility, Kinetic Feasibility)]. [Chemical Plant Operation (Material Balance, Energy Flow, Raw Materials, Safety, Pollution)]. Inorganic Commodity Chemicals (Sulfuric Acid, Phosphoric Acid, Chlorine Manufacture, Solvay Process). Synthesis Gas Processes, The Petrochemical Industry, Pollution Control.

CHE213 Advanced Organic Chemistry [Dyes & Aromatic]

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Advanced Organic Chemistry will be focused on the understanding of structure, reactivity, and underlying mechanisms of organic chemistry. The basic mechanisms of organic chemistry underlie the function of biopolymers, drugs, and manmade “smart” materials. A mechanism-focused curriculum will be a convincing demonstration of the pervasiveness and interdisciplinary nature of modern organic chemistry. This course shall provide the students with an understanding of the reactivity of organic and organometallic species that goes beyond arrow-pushing formalism.

CHE221 Inorganic Chemistry

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Inorganic nomenclature. Descriptive inorganic chemistry. Important industrial processes include availability of raw material and environmental aspects. Solid state structure and the properties of solid substances. Coordination compounds. The relationship between chemical bonding in Inorganic compounds and electronegativity, charges, size, polarizability, basic molecular orbital theory as well as basic band structure theory. Within these topics, the following is treated: chemical bonding, structure, thermodynamics, synthesis. Communication training with feedback.

CHE231 Quality Control

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Define quality in terms of processes, Requirements, and Improvement. Evolution of quality systems in manufacturing, Artisan – Apprentice and Inspection. Quality Control [Statistical Quality Control, Statistical Process Control]. Total Quality Management. Understanding and monitoring sources of variation (with piece, piece-to-piece, time-to-time). Constructing control charts (center line, spec limits, control limits, sample size). Define and understand costs associated with quality. Prevention costs. Appraisal costs. Costs of failure. Understand and describe quality systems [ISO 9000, Supplier Certification, ISO 17025, and ISO 14000].

CHE232 Chemical Properties and Analysis

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Topics include Introduction and Review: The Analytical Process, Chemical Measurements, Experimental Error. Chemical Equilibrium, Part 1 (Fundamentals, Acids, and Bases): Chemical Equilibrium, Activity and the Systematic Treatment of Equilibrium, Monoprotic Acid-Base Equilibria, Polyprotic Acid-Base Equilbria, Acid-Base Titrations. Electrochemistry: Fundamentals of Electrochemistry, Electrodes and Potentiometry, Redox Titrations, Electroanalytical Techniques. Chemical Equilibrium, Part 2 (Complexation, Precipitation, Advanced Topics): EDTA Titrations, Gravimetric Analysis, Precipitation Titrations, and Combustion Analysis, Advanced Topics in Equilibrium.

CHE233 Environmental Chemistry

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Stratospheric Chemistry: The Ozone Layer. The Ozone Holes. The Chemistry of Ground-level Air Pollution. The Environmental and Health Consequences of Polluted Air—Outdoors and Indoors. The Greenhouse Effect. The Chemistry of Natural Waters. The Pollution and Purification of Water. Toxic Heavy Metals. Pesticides. Dioxins, Furans, and PCBs. Other Toxic Organic Compounds of Environmental Concern. Wastes, Soils, and Sediments.

CHE234 Analytical Chemistry I

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

- Introduction to different types of volumetric analysis. - Acid-base (Aqueous titration). - Acid-base (non-Aqueous titration). - Complex formation titration (Complexometry). - Precipitate formation titration (Precipitemetry), - Redox titration. - Gravimetric methods of analysis.

CHE241 Renewable Energy and Sustainability

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

When the students successfully complete this course, they will be able to: Describe the principles of operation of the broad spectrum of renewable energy technologies. Analyze energy technologies from a systems perspective. Articulate the technical challenges for each of the renewable sources and discuss economic, technical and sustainability issues involved in the integration of renewable energy systems.

CHE242 Polymer Chemistry and Reaction Kinetics

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

The course gives a general introduction to polymers. Focus is placed on the classification and systematics of synthetic polymers and biopolymers. Polymer chemistry: Polymerization, kinetics, structure, and decomposition. Polymers in solution: thermodynamics, phase equilibria, diffusion, viscosity, polyelectrolytes, and gels. Solid state polymers: crystalline and amorphous polymers, thermodynamics, phase transitions and mechanical properties. Methods for characterizing and analyzing solid polymers and polymers in solution. In addition, statistical treatment of flexible chain molecules, thermodynamics and rheology of polymer systems are discussed.

CHE300 Chemical Kinetics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Topics include Introduction: elementary chemical engineering, chemical reactors classification. Kinetic models applications to the conception of ideal chemical reactors: “batch,” tubular reactors in the plug flow regime, perfectly stirred reactors in isothermal conditions; influence of the type of reactor on the products selectivity in complex reactions. Heterogeneous catalysis and catalytic reactors: chemical kinetics of heterogeneous catalytic reactions, kinetic at the catalytic pellet level. Non ideal reactors cause of the non-ideality, experimental approach of the time distribution, model of the tubular reactor with axial diffusion. Experimental techniques: chromatography, mass spectrometry, spectroscopy, fluorescence, photolysis, shock tubes, flow tubes. Thermodynamic and kinetic approaches of complex systems of dedicated examples: reactions in the atmosphere and in flames, autocatalysis, inhibition, estimate of thermodynamic data and kinetic parameters.

CHE311 Molecules and Reactions

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite CHE141

The following topics will be covered: (. properties of gases, (. internal energy, enthalpy & the First Law, (. entropy, free energy & the Second and Third Laws, (. phase equilibrium, (. simple mixtures, (. chemical equilibrium, (. molecular motion in gases and liquids, (. theory of reaction rates and experimental techniques, and. (. reaction mechanisms.

CHE312 Chemistry of Petrochemical Processes

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

The following topics will be covered: Production technologies of synthesis gas, olefins, and aromatic. Manufacture of important petrochemicals derived from base chemicals and synthesis gas. Production technologies of important polymers and plastics.

CHE313 Heterocyclic Compounds

2 Cr. Hrs. = (**2** LCT + **0** TUT + **1** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Classification of heterocyclic compounds. Nomenclature of monocyclic heterocyclic compounds as well as fused systems. Bonding, Structure, and geometry in heterocyclic compounds: three, four, five and six membered heterocycles Aromaticity – Basicity. Chemical reactions of heterocyclic compounds-ring opening reactions-ring opening with rearrangement reactions synthesis of saturated heterocycles. Unsaturated aliphatic heterocycles: azirines – oxiranes – diazirines. Aromatic heterocycles: azetes – diazete – oxete -thiaete and related compounds. Five membered heterocycles(pyrrolo-furan-thiophene): Aromaticity, chemical reactivity, and synthesis. π-Deficient heterocyclic compounds: Six membered heterocycles(pyridine): Aromaticity, chemical reactivity, and synthesis. Five and six membered heterocycles with two heteroatoms: chemical reactivity and synthesis. Benzo fused heterocycles and their derivatives: chemical reactivity and synthesis.

CHE314 Optical Organic Chemistry

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Spectroscopic methods for structure analysis such as mass spectrometry, nuclear magnetic resonance spectroscopy, infrared spectroscopy, and ultraviolet spectroscopy. Fundamentals of the NMR phenomenon, relationship between NMR spectra and molecular structure. Recording of routine spectra (1H and 13C), essentials of data processing (e.g., weighting functions). 1D NMR techniques: Decoupling, DEPT, relaxation measurement, magnetization transfer, NOE difference spectra. 2D NMR techniques: Homo- and heteronuclear correlation (COSY, TOCSY, HSQC, HMBC), measurement of the nuclear Overhauser effect (NOESY, ROESY). Emphasis is on learning the practical use of NMR equipment.

CHE315 Applied Organic Chemistry [Stereo, Lipids & Carbohydrates]

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

Stereochemistry: Optical, Geometrical and Conformational Isomerism: Optical activity, Polarimeter, Specific rotation, Enantiomers, Diastereomers, Optical activity in Lactic and Tartaric acid, R and S configuration of Optically active compound and E and Z designation of Geometrical isomers. Resolution of racemic mixture. Lipids: Fatty acids, neutral fats, long-chain alcohols, and long-chain bases. Soaps & Detergents, Fats & Oils, Waxes, Phospholipids, Prostaglandins, Terpenes, Steroids, Lipid Soluble Vitamins, Biosynthetic Mechanisms. Carbohydrates: Introduction, Classification, Configuration and Chemical reactions of mono, oligo, and poly saccharides, especially of Glucose, Fructose and Starch. Conversion of higher to lower and lower to higher aldose (Killiani Synthesis, Ruff & Wohl's Degradation). Conversion of Aldose to Ketose. Manufacturing of Cane Sugar from Sugarcane with flow sheet.

CHE316 Textiles &Dyes

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **- - -**

This course is designed for students whose career direction will require knowledge of textiles as part of the professional prerequisites of industry. Terminology, organization, and structure of this multi-faceted industry will be highlighted. Working fabric specimens (fabric swatches) will be used in conjunction with the assignments to enhance the combined textbook/hands-on format. Many changes are brought about constantly by technical advancements in the ever-changing environment of this highly technical industry. Major changes and

development in the world of textiles will be covered. The mounting emphasis of textiles as a major international industry will be examined, as well.

CHE317 Rubber, Detergents &Soap

1 Cr. Hrs. = (*1* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *60* – ECTS = *2*

Prerequisite - - -

Introduction, raw materials, classification and uses of rubber, Soaps, and Detergents. Rubber: fundamental aspects of rubber technology in a logical manner, from Material Selection, Compounding, Vulcanisation, Processing (conversion of raw materials into finished products), through to Mechanical Properties, Environmental Resistance, Testing and Specifications, Evaluation of product failure. Soap: Kinetics and phase reactions in soap boiling, physico-chemical properties of soap solutions, plants and processes employed in soap manufacture, recovery of by-products, various households and industrial soaps, soap additives, metallic soaps, miscellaneous application of soap-based products, testing and evaluation of soaps. Detergents: Chemistry and technology of synthetic detergents (anionic, cationic, non-ionic, and amphoteric), detergent additives, formulations and processing of detergent powders, tablets, liquid, and pastes for household and industrial applications, biosurfactants and enzyme detergents, dry cleaning systems. Environmental Issues: Biodegradation of surfactants, eutrophication and ecological aspects, eco-friendly washing systems, natural saponin based surfactants, modern trends in detergent formulations, testing and evaluation of synthetic surfactants.

CHE318 Scientific Writing

2 Cr. Hrs. = (*2* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

How do I write a thesis, and prepare other professional materials for presentation or publication? Topics covered in this course include searching the scientific literature; scientific writing style; writing graduate level papers, proposals, projects, and thesis components; preparing scientific presentations; presentation of data; using visual aids; and using word processing, spreadsheet, and presentation software.

CHE319 Journal Club

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite - - -

Each meeting of the journal club will have an assigned presenter. This person will provide the instructor with the title and citation information for the paper they have chosen to present at least one week in advance of their presentation. It is expected that the audience members will have read the paper prior to each meeting. The presenter will present (using presentation software such as PowerPoint or Keynote, overheads, or a suitable alternative) the background and context of the paper, the paper itself, and interpret the implications of the paper.

CHE320 Chemistry of Pesticides

1 Cr. Hrs. = (*1* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *60* – ECTS = *2*

Prerequisite - - -

. Pesticide classification on use, chemical nature, formulation, toxicity, and action etc. Various methods in Pesticide Formulation Analysis. Principles, operation, and application of various chromatographic techniques. Pesticide Dissipation, Residue Dynamics, Different methods/ Steps in residue analysis. Confirmative analytical techniques in residue analysis. Different terminologies are used in Pesticide Residue Analysis. Maximum Residue Levels in pesticide. Pesticide Management.

CHE321 Synthetic Frontiers of Inorganic Chemistry and Ligand Design

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **CHE221**

Reaction Mechanism: Substitution in octahedral and square planar complexes; lability, trans-effect, Conjugate base mechanism, racemization, Electron Transfer Reactions: inner sphere and outer sphere mechanism, Marcus theory. Inorganic photochemistry: Photo-substitution and photoredox reactions of chromium, cobalt and ruthenium compounds, Adamson's rules. Lanthanides and Actinides: Spectral and Magnetic Properties, NMR Shift reagents. Organometallic Chemistry: electron rule, metal carbonyls, nitrosyls, carbonyl hydrides, isolobal analogy, dioxygen, and dinitrogen compounds. Metal alkyls, carbenes, carbynes, alkenes, alkynes, and allyl complexes. Hydrides, Metallocenes, Metal arene complexes. Carbonylate anions, agnostic interaction, Oxidative addition and reductive elimination, insertion, and elimination reactions. Homogeneous and heterogeneous catalysis. Fluxional molecules. Metal-Metal bonding and Metal clusters.

CHE322 F-Block and Nuclear Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Nuclear theory. Radioactive decay, nuclear stability and mass-energy relationships, Interaction of radiation with matter, detection methods, nuclear reactors, neutron activation analysis, Applications of radioactivity, nuclear medicine, dating techniques-. f-block elements. Lanthanides and actinides –abundance and distribution, General properties including oxidation states, electronic configurations, Magnetic and spectral properties, Extraction and separation of lanthanides and actinides, Coordination chemistry of f-block.

CHE323 Materials and Nanoparticles

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

The course should give a basic introduction to chemical and physical principles in the synthesis of inorganic Nano-structured materials. In addition, basic principles of finite size effects will be covered. The course will also cover different methods for synthesis and characterization of different nanostructures and Nano-structured bulk materials. Prerequisites include general knowledge in chemistry, physics, and material science. The course forms the basis for teaching in TKP4190 Fabrication and Applications of Nanomaterials.

CHE324 Molecules in Action

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite ***CHE311***

The Periodic table, introductory quantum theory, Stoichiometry (within compounds and reaction stoichiometry), atomic structure, chemical bonding, coordination compounds, the phases of matter, solution chemistry, acid-base chemistry, solution equilibrium, thermodynamics, and thermochemistry.

CHE325 Spectroscopy and Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Introduction and Principles of Quantum Mechanics. Symmetry and Spectroscopy. Atomic Structure and Spectroscopy. Molecular Rotations. Molecular Vibrations. Magnetic Resonance Spectroscopy. Mass Spectrometry. UV-Visible Spectroscopy.

CHE326 Chemistry of materials

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite ***- - -***

In Chemistry of Materials, the students will learn the fundamental principles of the structure and properties of materials and the relationships between structure and electrical, mechanical, thermal, and chemical properties. The students will learn about metals, ceramics, multiphase systems, and polymeric materials.

CHE327 Molecular materials

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***- - -***

Polymer structure, thermodynamics for polymer solutions and polymer melts, adhesion, physically and chemically cross-linked gels, polymeric semiconductors, rheological concepts and relations, linear and non-linear viscoelasticity, electro-rheology.

CHE328 Synthesis and Characterization techniques of nanomaterials

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite ***- - -***

This course describes the most recent advances in the synthesis, fabrication, and characterization of nanomaterials. Topics to be covered: zero-dimensional materials, including nanoparticles, quantum dots and nanocrystals; one-dimensional materials including nanowires and nanotubes; two-dimensional materials including self-assembled monolayers, patterned surfaces, and quantum wells; three-dimensional materials including nano-porosity, nanocomposites, block copolymers and supra-crystals. Emphasis is made on the fundamental surface and size-related physical and chemical properties of nanomaterials and their applications in bio-sensing, nanomedicine, catalysis, photonics, and Nano-electronics.

CHE329 Solid state chemistry

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite ***- - -***

Fundamentals regarding the solid state, including selected structural examples. Theoretical and practical crystallography. Unary and binary phase diagrams. X-ray diffraction, thermal analysis, and introduction to other characterization techniques.

CHE330 Organometallic chemistry

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite ***- - -***

The theory of structure, bonding, and reactivity of transition metal compounds. This includes different types of ligands and their bonding modes, ligand substitutions and reactivity, and their roles in fundamental organometallic reactions important for catalysis (such as oxidative addition, reductive elimination, insertions, and beta-hydride elimination). The nature of catalysis includes basic principles, how its efficiency is measured (e.g., using TON and TOF), the advantages and disadvantages of homogeneous and heterogeneous catalysis and how to evaluate for which is operating in a particular reaction. Notable catalytic reactions, such as various forms of coupling reactions and hydrogenation.

CHE331 Skills for Chemists

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

How to draw chemical structures- Use of CHEMDRAW? Exercise – Dray the structure of Palytoxin or similar natural products in Chemdraw and do structure checking. How to write and draw equations (both chemical and mathematical). Exercise- Write the derivation of the Hydrogen atom energy function quantum mechanical Hamiltonian in microsoft word using equation editor and bring a hard and submit the soft copy online. How to find compound related data in the literature? How to find vendors, physical data, and chemical reaction data etc. Exercise- find vendors for PNA monomers. Use and management of mined data- End note –Students had to organize documents after retrieving all papers in e-format in week 4 and submit the same. Use of spectral databases and how to report compound data and procedures. Students had to submit experimental procedures in JOC format online for a synthetic procedure (such as cross coupling reaction or epoxidation). Use of other specialized databases- CCDC, PDB, other nuclei NMR databases. Search- all structures in the CCDC for Ir-Ir / Mo-Mo/ S- S/ bonds reported in crystal structures. Data integrity and recording experiments in the lab notebook. Students have to download a spectrum from SDBS and report proton and carbon spectra in JACS format. Plagiarism and scientific integrity –how to check for copycats-use of turnitin and ithenticate. How to write new and views (reviews)? Students were asked to write a review on a current topic (Nobel prize winners on 20. How to make presentation slides and present reviews to an audience? Refereeing scientific papers: How to spot errors? Overall summary and critical writing on a topic of the students' interest.

CHE332 Laboratory and Industrial Hazards

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Storage and transportation of chemicals, Risk management principles, Risk assessment techniques (HAZOP, HAZON, Fault Tree Analysis, Consequence Analysis), Onsite and offsite. emergency management, Human error Analysis and Accident Analysis.

CHE333 Theory, Analysis and Mechanisms

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Measurement Principles and Electronics: Introduction to the analytical process, Basic electronics, Signals, and noise. Basics of Spectroscopy: Introduction to Spectroscopic Methods. b. Components of Optical Systems. Atomic Spectroscopy: An Introduction to Optical Atomic Spectroscopy, Atomic absorption spectroscopy, Atomic Emission Spectroscopy. Molecular Spectroscopy – Electronic transitions: Introduction to UV-Vis molecular spectroscopy, Applications of UV-Vis spectroscopy, Fluorescence, phosphorescence and chemiluminescence. Molecular Spectroscopy – Vibrational excitation: IR absorption spectroscopy, Applications of Infrared Spectrometry. Molecular Spectroscopy – Nuclear transitions: NMR. Additional Instrumental Methods for Organic Structural Analysis: Mass Spectrometry. Separation Science: Fundamentals of chromatographic separations, Gas chromatography, High performance liquid chromatography.

CHE334 Green Chemistry and Sustainable Manufacturing

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

This course will present the fundamentals of the 12 principles of green chemistry and explore relevant examples of their practical use in commercial applications. This course will explore examples from a wide spectrum of industrial sectors including construction, personal care, pharmaceuticals, and electronics. Through examples, students will be presented with the premise that green chemistry offers organizations a boost to innovation and faster time to market. Course content will include lectures, readings, and site visits to the Warner Babcock Institute for Green Chemistry.

CHE335 Atmospheric Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

A detailed overview of the chemical transformations that control the abundances of key trace species in the Earth's atmosphere. Emphasizes the effects of human activity on air quality and climate. Topics include photochemistry, kinetics, and thermodynamics important to the chemistry of the atmosphere; stratospheric ozone depletion; oxidation chemistry of the troposphere; photochemical smog; aerosol chemistry; and sources and sinks of greenhouse gases and other climate forcers.

CHE336 Unit Process

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

An introduction to Organic Chemistry from a mechanistic perspective. Structure, bonding, and function, e.g., physical properties and reactivity. Stereochemistry, kinetics and thermodynamics, spectroscopy (nuclear magnetic resonance, infrared, ultra-violet/visible, and mass spectrometric techniques). Substitution and elimination reactions of saturated functional groups -the chemistry of alkanes, alkyl halides, alcohols, and their derivatives. Laboratory: Practical techniques.

CHE338 Analytical chemistry (instrumental analysis)

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction to quantitative techniques that include volumetric and gravimetric methods of analysis and data processing, and analysis and modeling using mathematical tools. Topics will also cover modern electrochemical techniques and instrumentation with emphasis on their applications in analytical chemistry. Topics include potentiometry, specific ion electrodes, DC and AC polarography, pulse polarography, coulometry, chronocoulometry, cyclic voltammetry, and rapid scan voltammetry.

CHE339 Advanced Physical chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Advanced class that deals with the essence of heterogeneous catalysis, including electro-catalysis and photo-catalysis. The lectures address principle of catalysis to discuss terminology, definition, and efficiency.

Discussion continues on concept of potential, the solid-state physics, preparation, and characterization of various classes of solid materials, kinetics, reaction mechanism, and various applications.

CHE340 Thin films nanostructure and surface science

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***- - -***

The contents of the course are designed to first deal with the underlying basic science, nucleation & growth, and epitaxy, then to establish a correlation between the deposition parameters and the resulting crystallographic structure, micro/Nano structure and the novel properties of the fabricated thin films and nanostructures.

CHE341 Reactivity

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***CHE111***

An introduction to Organic Chemistry from a mechanistic perspective. Structure, bonding, and function, e.g., physical properties and reactivity. Stereochemistry, kinetics and thermodynamics, spectroscopy (nuclear magnetic resonance, infrared, ultra-violet/visible, and mass spectrometric techniques). Substitution and elimination reactions of saturated functional groups -the chemistry of alkanes, alkyl halides, alcohols, and their derivatives. Laboratory: Practical techniques.

CHE342 Statistical Thermodynamics

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***CHE141***

This course will cover the subject of quantum and classical statistical thermodynamics. The course will focus on systems in equilibrium but some limited non-equilibrium topics such as time correlation functions will be introduced. To prepare and be successful for the close book tests, you must become proficient in solving problems and understanding the underlying theory behind them. Sometimes a particular topic is more clearly explained in one book than in some others. Several textbooks on this topic are available. We will not follow one particular book in this course; however, an abbreviated list of textbooks that I have used to prepare lectures appears later on this syllabus with their corresponding ISBN #. This course is demanding; we will cover a large amount of material this semester. You must spend enough time to keep up with the lectures. If you fall behind it will be extremely hard to catch up because topics are interconnected.

CHE343 Reactor Design

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***- - -***

Fundamentals of material and energy balances as applied to chemical reactor design for ideal reactors. Defining problems, analyzing data, and designing chemical processes. Rate laws and their derivation. Topics of heterogeneous catalysis, biological catalysis, and non-ideal reactor schemes.

CHE344 Macro Molecular Science

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite ***- - -***

The synthesis, characterization, microstructure, rheology, and properties of polymer materials. Polymers in solution and in the liquid, liquid-crystalline, crystalline, and glassy states. Engineering and design properties, including viscoelasticity, yielding and fracture. Forming and processing methods. Recycling and environmental issues. Synthesis, properties and processing of Nano-sized metal, metal oxide and

semiconductor powders. It will also include some organic/inorganic and Nano biomaterials. The emphasis will be on particle properties and the use of these particles to make Nano-structured shapes.

CHE345 Silicon Technology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

It provides the science, technology, and manufacturing of semiconductor silicon materials. Every known property of silicon is detailed. A complete set of binary phase diagrams is included. Practical aspects such as materials handling, safety, impurity, and defect reduction are also discussed in depth. Fundamentals in the areas of silicon precursor compounds, polysilicon, silicon crystal growth, wafer fabrication, epitaxial and CVD deposition are addressed by experts in these fields. Materials properties covered include electrical, optical, and mechanical properties, deep level impurities and carrier lifetime, and thermochemistry, as well as specific sections on oxygen, carbon, and nitrogen impurities.

CHE346 Thermochemistry &Kinetics

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Fundamental Theory of Thermodynamics [Energy concepts, simple systems, and profound fundamentals, Equations of state and thermodynamic variables, First law: heat, work and energy conservation, Thermochemistry, Entropy]. Applications of Thermodynamics [The second (and more interesting) law of thermodynamics, Applying the laws of thermodynamics to boring systems, Phase equilibria in one-component systems, Solutions and multicomponent phase equilibrium, Chemical equilibrium, which you already know, Qualitative thermochemistry: developing an intuition]. Special Topics [Thermo meets quantum: an introduction to statistical thermodynamics, Introduction to kinetic principles, Statistical rate theory and transition state theory, The Michaelis-Menton model of enzyme kinetics].

CHE347 Electrochemistry &Surface Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

This course deals with structure of solid surfaces, adsorbate overlayers, physical and electronic properties of surfaces, bonding, and reactions of atoms/molecules on clean single crystal surfaces, kinetics and thermodynamic aspects of surfaces, adsorption and catalysis on surfaces, surface science approach to heterogeneous catalysis, imaging, and spectroscopic methods of investigating clean surfaces and surface processes, photoelectrochemistry and electrocatalysis on surfaces.

CHE348 Fluid Flow, Heat & Mass Transfer

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

This course provides one of the fundamental phenomena and concept that must be given to chemical engineering students. Through this course, student will learn the concept and operations of heat and mass transfer devices which are typically inseparable from any chemical engineering industrial processes and design. Students will also have the opportunity to utilize the basics and mathematics that they have learned so far and use these techniques to solve the complex problems in heat and mass transfer operations.

CHE349 Thermal &Nuclear Analysis

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Y will learn the fundamentals of reactor physics and gain a unique perspective on the derivation of the neutron transport equation, and understand some approximations to this equation, including neutron diffusion. We will solve many application problems that incorporate elements of nuclear physics, radiation interactions, critical eigenvalues, diffusion theory, and transport theory. Definition of thermal analysis and overview of methods; Differential scanning calorimetry - principle and applications; Differential thermal analysis - principle and applications; Thermogravimetry - principle and applications; Simultaneous thermal analysis; Methods based on the dimensional changes of the sample (dilatometry, TMA, DMA); Chemiluminescence - principle and applications; Other thermoanalytical methods.

CHE350 Glass, Ceramic &Cement

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

a) General: Definition & scope of ceramics and ceramic materials, classification of ceramic materials – conventional and advanced ceramics. b) Pottery & Whitewares: Classification and type of pottery & whitewares, elementary idea of manufacturing process technology including body preparation, basic properties, and application areas. c) Glass: Definition of glass, glass raw materials and their functions, elementary concept of glass manufacturing process specially for container glass, different types of glasses, application of glasses. d) Refractories: Definition of refractory, properties of refractories, classification of refractory, manufacturing process, basic areas of application specially in steel plant. e) Cement & Concrete: Concept of hydraulic materials, raw materials and manufacturing process, basic compositions, setting and hardening, concrete. f) Advanced Ceramics: Engineering ceramics, ceramics used in advanced applications, ceramics for medical and scientific products, ceramics for electrical and electronic, aerospace.

CHE411 Synthesis and Pericyclic Reactions

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *CHE211*

The course will involve a discussion of molecular organic photochemistry and pericyclic reactions. Initially, we will study in brief the fundamental principles of photochemistry. In the following lectures we will discuss the primary photochemical reactions of n, π* states. In the second half of our course, we will be focusing on the primary photochemical reactions of π, π* states, where we will discuss in detail the pericyclic reactions. We will end our course by studying some important applications of photochemistry.

CHE412 Fundamentals of Magnetic Resonance

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Spectroscopy is the study of the interaction of electromagnetic radiation with matter. There are two oscillating components in radiation, namely an oscillating electric field and an oscillating magnetic field which are mutually perpendicular and also perpendicular to the direction of propagation of radiation. The study of interaction of electric field component of radiation with the electric fields present in matter is the subject of optical spectroscopy. The study of magnetic field component of radiation with magnetic properties of the nuclei and their modifications

due to the surrounding electric fields present in molecular systems is the subject nuclear magnetic resonance spectroscopy. In this course an elementary account of nuclear magnetism will be presented along with the necessary quantum mechanical tools to understand nuclear angular momentum and the magnetic moment. This will be followed by an elementary description of some of the most important experimental techniques in one- and two-dimensional NMR that have evolved since the first report of successful NMR in. Simple analysis of NMR spectra for molecular structure determination will be provided, emphasizing chemical intuition. Modern NMR instrumentation and data processing fundamentals will also be given.

CHE413 Agro-Based Industries & Industrial Processes

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Fats, oils, and waxes. Sugar. Ethanol, beer, wines vinegar, citric acid, and yeast. Furfural. Starch, dextrin, and glucose. Pulp and paper, Natural fibers. Wood products. Gums, resins, and essential oils. Tea, coffee; fruits and vegetable processing. Leather. Tallow. Milk processing. Animal feed production. Food waste management. Waste management in the agro-based industries.

CHE414 Unit Processes in Organic Chemistry

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Plastics processing industry, including thermoplastics and thermosets. Description, classification, and properties of common plastics and processes and current trends in the industry. Refinery Introduction and Crude Oil Composition, Physical Properties and Classification of Crude Oils, Overall Refinery Flow, Separation Processes. Distillation of Crude Oil, Distillation in Light Ends Unit, Deasphalting, and Dewaxing Processes, Thermal Conversion Processes, Catalytic Conversion Processes. Catalytic Cracking and Hydrocracking, Catalytic Reforming, Alkylation, Polymerization, and Isomerization, Finishing Processes: Hydrotreating and Blending, Natural Gas Processing.

CHE415 Petroleum &Polymer Processing

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Plastics processing industry, including thermoplastics and thermosets. Description, classification, and properties of common plastics and processes and current trends in the industry. Refinery Introduction and Crude Oil Composition, Physical Properties and Classification of Crude Oils, Overall Refinery Flow, Separation Processes. Distillation of Crude Oil, Distillation in Light Ends Unit, Deasphalting, and Dewaxing Processes, Thermal Conversion Processes, Catalytic Conversion Processes. Catalytic Cracking and Hydrocracking, Catalytic Reforming, Alkylation, Polymerization, and Isomerization, Finishing Processes: Hydrotreating and Blending, Natural Gas Processing.

CHE416 Inorganic Polymers

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Introduction. Characterization of Inorganic Polymers. Polyphosphazenes. Polysiloxanes and Related Polymers. Polysilanes and Related Polymers. Ferrocene-Based Polymers, and Additional Phosphorus- and Boron-Containing Polymers. Miscellaneous Inorganic Polymers. Inorganic-Organic Hybrid Composites. Preceramic Inorganic Polymers.

CHE417 Formulation Chemistry &Technology

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

The meaning of cosmetics and cosmetology. Cosmetology as a science and academic discipline. EU legislation in the field of cosmetic products (cosmetics). Boundaries and possibilities of cosmetics. Definitions cosmetic ingredients, cosmetic product, a comparison with the drug and medicine. Borderline products. Prohibited, regulated, and authorized agents for cosmetic products. International labeling of cosmetics ingredients (INCI). Basic functional cosmetic ingredients hydrophilic - species, chemical nature, properties. Basic lipophilic functional cosmetic ingredients - species, chemical nature, properties. Hydrophilic colloids in cosmetics - species, chemical nature, properties. Surfactants in cosmetics - species, chemical nature, properties. Basic specific cosmetic ingredients - species, chemical nature, properties. Types and marketing of cosmetic products. Principles of technology of liquid cosmetics and frame formulation. Principles of technology of emulsion cosmetics and frame formulation. Principles of technology of gel cosmetics and frame formulation. Principles of technology of suspension cosmetics and frame formulation.

CHE418 Fine Chemicals for Pharmaceuticals

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Industrial Organic Chemicals & Carbon Source, Petroleum Refining Process, Introduction to Petrochemicals, C2 Chemistry/Chemicals, Chemistry/Chemicals from Propylene, Chemicals from BTX, Surfactants Handout, Halogen Compounds Handout, Synthesis of Fine Chemicals.

CHE419 Graduation Project

4 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **- - -**

Literature survey. Data collection. Finding a research question. Establishing the first prototype.

CHE421 Electronic States of Atoms and Molecules

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite ***CHE221***

After reviewing basic quantum mechanics, including the “simple hydrogen atom” (i.e., single electron moving in the Coulomb field of the nucleus), we will move on to more advanced topics including relativistic corrections to the simple picture, atoms in electromagnetic fields, multi-electron atoms, and electronic states and vibrations of simple molecules. Topics include Review of Quantum Mechanics and Simple One-Electron Atoms. Additional Interactions in One-Electron Atoms. Multi-Electron Atoms. Molecules.

CHE422 Electronic Spectra and Photochemistry of Tm Complexes

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Basic principles: Absorption of light –photochemical laws – photostationary states – rate law – photolysis – quantum yields – actinometry – scavenging of reaction intermediates – flash photolysis – single photon techniques – flow techniques – picosecond transient kinetics. Kinetics of photoluminescence: Thermal effects of photoluminescence – luminescence yield – time resolved detection of excited states – radiative and non-radiative transitions – energy transfer.

Photoredox reactions: Charge transfer complex – theory of electron transfer reactions – reactivity of CTTM, CTTL excited states – medium effects. Ligand field photochemistry: General features of ligand field photochemistry – reaction of excited states of dn metal complexes. Organometallic photochemistry: Excited states in organometallic compounds – metal carbonyls – compounds with or M – C bonds – hydride complexes.

CHE423 Electronic Properties of Materials

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

This course offers an overview of the electronic, optical, and thermal properties of materials. It covers the fundamental concepts of band structure and bonding of materials, electrical and thermal conduction in metals, semiconductors, and dielectrics. The interaction between light and matter will be addressed and important concepts introduced. Specific topics that will be covered include Crystal Structures & Lattices, Reciprocal Lattice, Free Electron Theory, Introductory Band Theory, Semiconductor Materials, Dielectric Materials, Electronic Devices, Introductory Phonons & Thermal Properties, Introductory Light Matter Interactions.

CHE424 Supramolecular and Nanoscale Chemistry

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

knowledge on nanotechnology based alternate source of energy. advanced materials for renewable and green energy. Solar technology. importance of energy storage techniques. the role of nanotechnology in improving efficiency in energy usage.

CHE425 Molecular modeling and simulation

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Topics will span three core techniques: molecular dynamics, Monte Carlo, and first principles (ab initio) methods. Introduction to molecular modelling. Aims and problems of molecular modelling. Standard tools of molecular modelling. Molecular mechanics. Finding equilibrium structures. Geometry optimization. Simulations under real conditions. Visualization and molecular properties. Applications of molecular modeling. Simulation of large molecules. Ligand-receptor docking. Trends in molecular modeling.

CHE427 Photochemistry of nanomaterials

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Physics and Chemistry of Nanomaterials. Electronic Structure of Nanomaterials. Solution Chemistry of Nanomaterials. Adsorption in Nano-porous Materials. Nano-porous Catalytic Materials. Self-assembly and Colloidal Phenomena. Nanostructured Fuel Cells and Solar Cells. Scattering Theory and Diffraction. Electron Microscopy and Nuclear Magnetic Resonance (NMR).

CHE428 Practical Training and Internship

4 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***4*** LAB + ***0*** OTH) – SWL = ***210*** – ECTS = ***8***

Prerequisite **- - -**

The course provides the student with an opportunity to gain knowledge and skills from a planned work experience in the student's chosen career field. In addition to meeting Core Learning Outcomes, jointly developed Specific Learning Outcomes are selected and evaluated by

the Faculty Internship Advisor, Work-site Supervisor, and the student. Internship placements are related to the student's program of study and provide learning experiences not available in the classroom setting. Internships provide entry-level, career-related experience, and workplace competencies that employer's value when hiring new employees. Internships may also be used as an opportunity to explore career fields. Students must meet with an Internship Education Program Advisor prior to registering.

CHE429 Nanosurface chemistry

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Intermolecular forces and forces between surfaces. Surface tension, wetting, contact angles, and monomolecular films. Adsorption from gas, liquid and solution, and interactions between proteins and surfaces. Surface analysis. Reactions at interfaces. Formation of nanoparticles: Nucleation and micellar formation. Electrical double layers, electro kinetics and stability of dispersions and emulsions. Adhesion mechanisms and technology.

CHE430 Advanced instrumental analysis

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

The course will provide students with the knowledge and skills needed to conduct laboratory research, understand instrument design, and analyze instrumental results. Over the duration of the course, you will be expected to learn the theory behind a range of instrumental techniques, instrumentation hardware and data analysis techniques. The class will cover the theory of spectroscopic techniques, mass spectrometry, ion mobility, high performance liquid chromatography, gas chromatography and computational modeling.

CHE431 Advanced Separations and Mass Spec.

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Solid Waste analysis and characterization, Hazardous waste Characterization Environmental legislation for solid and hazardous waste disposal and transport Risk Assessment, Waste minimization and resource recovery, Waste stabilization techniques, Chemical, physical and biological treatment Landfill design for Sanitary and Hazardous Wastes, Incineration.

CHE432 Hazardous Waste Management

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Solid Waste analysis and characterization, Hazardous waste Characterization Environmental legislation for solid and hazardous waste disposal and transport Risk Assessment, Waste minimization and resource recovery, Waste stabilization techniques, Chemical, physical and biological treatment Landfill design for Sanitary and Hazardous Wastes, Incineration.

CHE433 Nanoscale sensors and biosensors

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Topics include Introduction to biosensors. Applications of biosensors. Transducers and sensor systems. Bio-receptors and their immobilization. Synthetic receptors and nanomaterials for biosensors. Design parameters for catalytic biosensors. Design of affinity biosensors. Microfluidics and arrays. Surface Plasmon resonance for bio-affinity monitoring. Patenting and litigation in the field of biosensors.

Commercializing biosensors. Ethics and future prospects. The course will also cover the major types of electronic nano-biosensors for biological signal detection and their applications in the field of neural engineering and early disease detection.

CHE434 Application of membrane technology and surface science

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Topics include Introduction to Membrane Science. Membrane Structures and Functionality. Transport in Membranes. Materials Science of Membranes. Membrane Formation. Membrane Modification. Membrane Characterization. Membrane Processes (MF, UF, NF, RO, Gas Separation). Modules and System Design.

CHE435 Pharmaceutical nanotechnology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

This course offers an introduction to the interdisciplinary field of nanomedicine for students with physical, chemical, or biological sciences background. This course will emphasize emerging nanotechnologies and biomedical applications including nanomaterials, Nano-engineering, nanotechnology-based drug delivery systems, Nano-based imaging and diagnostic systems, nano-toxicology, and translating nanomedicines into clinical investigation.

CHE436 Industrial chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Fundamentals [Chemical Reactions, Stoichiometry, Reaction Yields, Thermochemistry, Equilibrium, Equilibrium Constants, LeChatlier's Principle, Kinetics, Rate Expressions, Temperature Effects, Catalysis]. Industrial Considerations [Reaction Evaluation, Selection Economic Feasibility, Thermodynamic Feasibility, Kinetic Feasibility, Chemical Plant Operation, Material Balance, Energy Flow, Raw Materials, Safety, Pollution. Industrial Metallurgy [Ferrous Metals, Non-Ferrous Metals, Alloys]. Inorganic Commodity Chemicals [Sulfuric Acid, Phosphoric Acid, Chlorine Manufacture, Solvay Process]. Synthesis Gas Processes [Synthesis Gas Production, Steam Reforming, Shift Reactions, Methanation, Ammonia, Synthesis, Oxidation, Nitric Acid, Fertilizers, Methanol, Synthesis, Derivatives, Formaldehyde, Acetic Acid. The Petrochemical Industry [Petroleum Refining, Distillation, Cracking, Reforming, Hydro-treating, Alkylation and Isomerization, Steam Cracking, Ethylene-Based Processes, Ethylene Oxide and Ethylene Glycol, Polyethylene, Vinyl Chloride and PVC, Propylene-Based Processes, Acrylic Acid and Acrylonitrile, PP and Ziegler-Natta Chemistry, C. Based Processes, Butadiene, Isobutylene, BTX Processes, Styrene and Polystyrene, Polyethylene Terephthalate (PET), Phenol, Adipic Acid and Nylon, Phthalic Anhydride. Pollution Control [Automotive Exhaust Emission Control].

CHE441 Processes At Surfaces

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Physical and chemical weathering and soils. Hillslopes and mass movement processes. Fluvial processes. Glacial processes.

CHE442 Catalysis With Green Technologies

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Definition of terms; the concept of catalysis; mechanism of catalysis; role of catalysis in the chemical industry; types of catalysis; properties

of catalysts; methods for characterization of catalysts; factors that determine industrial use of catalysts; catalyst deactivation; catalyst recycling and management; examples of industrial applications of catalysts: Wacker process, catalytic cracking with zeolites, catalytic reforming, Fischer-Tropsch process, Harber process, Contact process, Ziegler-type catalysts in polymerization.

CHE443 Introduction to Quantum Chemistry

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

In this course, you will learn the basics of how to describe the electronic structure of atoms and molecules and their time-dependent behavior in the framework of quantum mechanics.

CHE444 Molecular Modeling and Simulation

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Topics will span three core techniques: molecular dynamics, Monte Carlo, and first principles (ab initio) methods. Introduction to molecular modelling. Aims and problems of molecular modelling. Standard tools of molecular modelling. Molecular mechanics. Finding equilibrium structures. Geometry optimization. Simulations under real conditions. Visualization and molecular properties. Applications of molecular modeling. Simulation of large molecules. Ligand-receptor docking. Trends in molecular modeling.

CHE445 Dynamic Electrochemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Introduction to electrochemistry: Nernst equation, electrode kinetics, dynamic electrochemistry, the Butler-Volmer and Tafel equations. Over-potentials. Kinetic and mass transport controlled electrochemical processes. Mass transport by migration, convection, and diffusion. Conductivity. Solid state electrochemistry. Ion conducting and electronically conducting polymers. The electrochemical double layer. Potentiostatic and Galvano-static electrochemical methods including chronoamperometry, coulometry, cyclic voltammetry, chronopotentiometry, ac impedance spectroscopy, spectroelectrochemistry and hydrodynamic methods. Surface confined electrochemical processes. The fundamentals of corrosion. Homogeneous and heterogeneous electrocatalysis. Electrochemical processes coupled to chemical steps. Nanostructured and surface modified electrodes. Introduction to batteries, fuel cells and electrochemical solar cells. Electrochemical processes of particular relevance to energy conversion.

CHE446 Computational Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

Introduction to molecular modeling and applications. Simulation methods: nanoscale to mesoscale simulations. Force fields: knowledge-based, classical, polarizable potentials. Environment: Vacuum, implicit, explicit, and polarizable solvents. Systems: Protein-ligand docking, interactome based drug discovery. Free energy calculations in the context of simulation and potential functions.

CHE447 Applications of Quantum Chemistry

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

In this course, you will learn about the primary perturbative methods in quantum mechanics: degenerate and non-degenerate time-independent perturbation theory, the semi-classical WKB

approximation, time-dependent perturbation theory, the adiabatic approximation, and scattering theory. We will use these methods to study a variety of systems that do not admit analytic solutions, including the fine structure of hydrogen, tunneling rates, radiative decay, and molecules. We will also investigate the quantum mechanical description of a particle in a magnetic field, and discuss the symmetries associated with multi-particle systems in detail.

CHE448 Nanochemistry &Solar Energy

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

knowledge on nanotechnology based alternate source of energy. advanced materials for renewable and green energy. Solar technology. importance of energy storage techniques. the role of nanotechnology in improving efficiency in energy usage.

CHE449 Metal Corrosion &Its Protection

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

The course concerns fundamental theory of the thermodynamics and kinetics of the corrosion process of metals and alloys as well as polymer materials both in atmosphere and water solutions. Focus is put on electrochemical aspects and the influences of the properties of the metals and their oxides on the corrosion behavior, which is exemplified by different corrosion types. Existing corrosion protection strategies, including surface treatments and coatings are described and choice of material is discussed from a corrosion point of view.

CHE495 Special Topic

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***1*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Advanced topics related to field.

Department of Physics

PHY111 Physics I

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

This course starts with the basics of classical mechanics and its extension into other area of physics. Classical Mechanics topics are Motion in One Dimension, Vectors, Motion in Two Dimensions, The Laws of Motion (Newton's First Law, Newton's Second Law, and Newton's Third Law), Circular Motion and Other Applications of Newton's Laws. Energy and Energy Transfer, Potential Energy, Linear Momentum and Collisions, Rotation of a Rigid Object about a Fixed Axis, Angular Momentum, Static Equilibrium and Elasticity, Universal Gravitation, Fluid Mechanics, Temperature.

PHY119 Laboratory Safety and Good Laboratory Practice

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Material safety data sheets. Good lab practices. Good manufacturing practices. Fire safety. Regulatory agencies. Safe use of lab equipment & chemicals. Using emergency equipment. Safety planning.

PHY211 Physics II

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

This course starts with the basics of classical mechanics and its extension into other area of physics. Classical Mechanics topics are: Electric Fields, Gausss Law, Electric Potential, Capacitance and Dielectrics, Current and Resistance, Direct Current Circuits, Magnetic Fields, Sources of Magnetic Field, Faradays Law, Inductance, Alternating Current Circuits, Electromagnetic Waves, The Nature of Light and the Laws of Geometric Optics, Image Formation.

PHY212 Introduction to Engineering Physics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Scalars and vectors. Force and motion. Motion in one, two, and three dimensions. Energy and momentum. Rotational motion and gravity. Solids and fluids. Vibrations and waves. Electricity and magnetism. Geometric and optics.

PHY213 Biological Imaging: The Use of Microscopy to Observe & Photograph Life

3 Cr. Hrs. = (*1* LCT + *0* TUT + *3* LAB + *1* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Light microscope. Fundamental limits in light microscopy. Special optical elements. Digitizing image data. Laser sources for microscopy. Wavelength expansion through nonlinear techniques. Difference between 3D imagining and 2D imaging. filmmaking techniques, web design, 3D technology.

PHY221 Introduction to Nanoscience

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **CHE141CHE221**

What is nanotechnology? Definitions, History of nanotechnology, Context of nanotechnology. Motivation for nanotechnology: Materials, Devices, Systems, Issues in miniaturization, other motivations. Scaling laws: Materials, Forces, Device performance, Design. Nano-metrology: Imaging nanostructures, Nonimaging approaches, other approaches, Metrology of self-assembly. Raw materials of nanotechnology: Nanoparticles, Nanofibres, Nanoplates, Graphene-based materials, biological effects of nanoparticles. Nano-devices: Electronic devices, Magnetic devices, Photonic devices, Mechanical devices, Fluidic devices, Biomedical devices. Nano-facture: Top-down methods, Molecular manufacturing, Bottom-up methods, Intermolecular interactions. Bio-Nanotechnology: Biomolecules, Characteristics of biological molecules, Mechanism of biological machines, biological motors, The cost of control, Bio-photonic devices, DNA as construction material. New fields of nanotechnology: Quantum computing and spintronics, Nanomedicine, Energy, Three concepts. Implications of nanotechnology: Enthusiasm, Neutrality, Opposition and skepticism, A sober view of the future.

PHY231 Electromagnetic Wave

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **PHY211**

Review of vector algebra and calculus, coordinate transformations. Fundamental electromagnetic concepts: Maxwell's equations, Lorentz force relation, electric and magnetic polarizations, constitutive relations, boundary conditions, Poynting theorem in real and complex forms, energy relations. Solution of the Helmholtz equation: plane, cylindrical, and spherical waves, potentials. Electromagnetic theorems: uniqueness, duality, reciprocity, equivalence, and induction theorems, Huygen's and Babinet's principles. Superposition behaviour of electromagnetic waves (interference of electromagnetic waves and their devices). Behaviour of electromagnetic wave at boundaries (dielectric, metals) reflection transmission and absorption. Polarization of electromagnetic waves. Guided fields: waveguides, dispersion, phase and group velocities, attenuation, inhomogeneous waveguides, and resonant cavities.

PHY232 Modern Physics

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **PHY 211**

Quantization of Charge, Light, and Energy. Which include Quantization of Electric Charge ((e/m) and millikan's experiments), Blackbody Radiation and Plank's quantum idea of light wave, The Photoelectric Effect (concept of photon energy), X-Ray Spectra and its production, X Rays, and the Compton Effect (concept of photon momentum), Derivation of Compton's Equation. The Nuclear Atom. Rutherford's Nuclear Model, Rutherford's Prediction and Geiger and Marsden's Results, Atomic Spectra, The Bohr Model of the Hydrogen Atom, The Franck-Hertz Experiment, A Critique of Bohr Theory and the "Old Quantum Mechanics." The Wavelike Properties of Particles. The de Broglie Hypothesis, Measurements of Particle Wavelengths, Wave Packets, The Probabilistic Interpretation of the Wave Function, The Uncertainty Principle (development of The Gamma-Ray Microscope, Some Consequences of the Uncertainty Principle, Wave-Particle Duality, Two-Slit Interference Pattern. Relativity I: The Experimental Basis of Relativity, Michelson-Morley Experiment, Einstein's Postulates, The Lorentz Transformation, Calibrating the Space-time Axes, Time Dilation and Length Contraction, The Doppler Effect, Transverse Doppler Effect, Relativistic Momentum, Relativistic Energy, Mass/Energy Conversion and Binding Energy.

PHY281 Biophysics

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Mechanical properties of matter including the elastic properties of bones and tissues. Statics and dynamics study in human body. Heat transfer, temperature, and thermal properties of the materials. Radiation is used in the life sciences, X-rays, computerized tomography CT, magnetic resonance imaging, PET, radiation therapy, food preservation by radiation, isotopic tracers, measure the radiation dose and carbon dating. Circulation of the blood, blood pressure and power produced by heart. Non-viscous and viscous fluids. Electricity and nervous system. Force, work, energy, and power in biological systems. Transport of molecules by diffusion, respiratory system, surfactants and breathing, diffusion and contact lenses.

PHY311 Introduction to Quantum Mechanics

2 Cr. Hrs. = (**1** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **105** – ECTS = **4**

Prerequisite **PHY232**

Review of Classical Theories: Harmonic Oscillator, Boltzmann Distribution Function, Maxwell's Equations and EMWaves, the basics of modern physics. Schrödinger-Wave Equation, Operator Algebra and Basic Postulates, Eigen-equation, Eigen-function and Eigenvalue, Properties of Eigen-functions, Commutation Relation and Conjugate Variables, Uncertainty Relation. Bound States in Quantum Well, Wire and dots: Electrons in Solids, 1D, 2D, and 3D Densities of States, Particle in Quantum Well, Quantum Well, wire and dots. The Quantum Treatment of Harmonic Oscillator: Energy Eigen-function and Energy Quantization, The Properties of Eigen-functions, HO in Linearly Superposed State, The Operator Treatment of HO, Creation and Annihilation Operators and Phonons. Scattering and tunneling of 1D Particle, scattering at the Step Potential, scattering from a Quantum Well, Tunneling, Direct and Fowler–Nordheim Tunneling, Resonant Tunneling, The Applications of Tunneling, Metrology and Display, Single-Electron Transistor. Schrödinger Treatment of Hydrogen Atom, Angular Momentum Operators, Spherical Harmonics and Spatial Quantization, The H-Atom and Electron–Proton Interaction, Atomic Radius and the Energy, Eigen-function, Eigen-function, and Atomic Orbital. Molecules and Chemical Bonds, Ionized Hydrogen Molecule, H2 Molecule and Heitler-London Theory, Ionic Bond, van derWaals Attraction, Polyatomic Molecules and Hybridized Orbitals.

PHY312 Statistical Mechanics

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **PHY311**

Basic concepts: including heat, micro and macro-states. Basic concepts of probability theory and statistical distributions. Boltzman definition of entropy. First law and Second Law of Thermodynamics. Thermodynamic potentials: Enthalpy, Helmholtz, Gibbs, etc. Maxwell equations. Examples: thermodynamic gas cycles, thermal machines, and refrigerators. Statistical weight of microstate, microcanonical ensemble. Examples: Entropy of mixing, binary alloy, Schottky defects, paramagnetic spins. Canonical ensemble, Boltzman distribution and partition function. General definition of entropy. Lattice vibrations in crystals. Third law of thermodynamics. Partition function for the classical ideal gas. Maxwell velocity distribution equipartition theorem. Grand canonical ensemble. Quantum gases Bose-Einstein, Fermi-Dirac and photon distributions, free electron gas, black body radiation.

PHY313 Electrodynamics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY231**

Electrostatics: Coulomb's law, The electrostatic field, Magneto-statics, Ampère's law, The magneto-static field. Electrodynamics: Equation of continuity for electric charge, Maxwell's displacement current, Electromotive force, Faraday's law of induction, Maxwell's microscopic equations, Maxwell's macroscopic equations. Electromagnetic Waves: Introduction, The wave equations, The wave equation for E, The wave equation for B, The time-independent wave equation for E, Plane waves. Electromagnetic Potentials, Introduction, The electrostatic scalar potential, The magneto-static vector potential, The electrodynamic potentials. Electromagnetic Fields and Matter: Introduction, Electric polarization and displacement, Electric multipole moments, Magnetization and the Magnetizing field, Energy and momentum, The energy theorem in Maxwell's theory, The momentum theorem in Maxwell's theory. Electromagnetic Fields from Arbitrary Source Distributions: Introduction, the magnetic field, the electric field, the radiation fields, Radiated energy, Monochromatic signals, Finite bandwidth signals. Electromagnetic Radiation and Radiating Systems: Introduction, Radiation from extended sources, Radiation from a one–dimensional current distribution, Radiation from a two–dimensional current distribution, Multipole radiation, The Hertz potential, Electric dipole radiation, Magnetic dipole radiation, Magnetic quadrupole radiation, Radiation from a localized charge in arbitrary motion, The Lienard-Wiechert potentials, Radiation from an accelerated point charge.

PHY319 Journal Club

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB + ***0*** OTH) – SWL = ***90*** – ECTS = ***4***

Prerequisite **- - -**

Each meeting of the journal club will have an assigned presenter. This person will provide the instructor with the title and citation information for the paper they have chosen to present at least one week in advance of their presentation. It is expected that the audience members will have read the paper prior to each meeting. The presenter will present (using presentation software such as PowerPoint or Keynote, overheads, or a suitable alternative) the background and context of the paper, the paper itself, and interpret the implications of the paper.

PHY321 Crystallography and Bonding

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **CHE141CHE221**

Crystal structures; points, directions and planes; unit cell; Bravais lattice; basis; symmetry- translation, rotation, inversion; 32 Crystallographic Point Groups; 230 Space Groups; real and reciprocal Lattices; Brillouin zones; application of reciprocal lattices to diffraction- scattering from electrons, atoms, crystals; structure factor; van der Waal's, ionic, covalent and metallic bonding; classical versus quantum mechanical picture of bonding; particle-wave duality, metallic solid; covalent solid; structures of metals and alloys, structure of ceramics, structure of polymers, structure determination by x-ray diffraction, importance of defects on properties; point and line defects.

PHY322 Solid State Physics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY321**

Fundamentals regarding the solid state, including selected structural examples. Theoretical and practical crystallography. Advanced topic in solid state physics.

PHY323 Solar Photovoltaic Energy Conversion I

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY232**

The course provides an overview of the Solar Photovoltaic Energy Conversion. Students learn the following subjects: SOLAR CELL FUNDAMENTALS. Semiconductors, p-n Junction, Generation of Electron-Hole Pair by Photon Absorption, Photoconduction. SOLAR CELL CHARACERISTICS. I-V Characteristics, Effect of Variation of Insolation and Temperature, Energy Losses and Efficiency, Maximizing the Performances, Cell size, Energy Payback Period (EPP). CLASSIFICATION OF SOLAR CELL. On the Basis of Thickness of Active Material, On the Basis of Junction Structure, On the Basis of Type of Active Material, Single Crystal Silicon Solar Cell, Multicrystalline Silicon Solar Cell, Gallium Arsenide Cell, Copper Indium Diselenide Cell, Amorphous Solar Cell. SOLAR CELL, MODULE, PANEL, AND ARRAY CONSTRUCTION. Solar Cell, Solar PV Module, Solar PV Panel, Solar PV Array.

PHY324 Nanochemistry and physics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY221CHE141CHE221**

A. Introduction to nanophysics and nanotechnology – scaling laws and limits to smallness; quantum nature of nano-world; Nano fabrication (top-down and bottom-up process); nanoscopy (electron microscopy, atomic force microscopy, scanning tunneling microscopy). B. Properties and application of dielectric and metal nanostructures - individual nanoparticles and nanoclusters; nanostructured materials; carbon nanostructures; nano-magnets. C. Properties and application of semiconductor nanostructures - fabrication of semiconductor nanowires and quantum dots; electronic and optical properties (2D and 3D quantum confinement); optical spectroscopy of semiconductor nanostructures (local probe techniques); quantum dots nanowire- and quantum-dot-based electronic and photonic devices.

PHY325 Functional materials

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY221CHE141CHE221**

The course is focused on the properties of materials used in modern technology. The topics covered include review of crystal structures, bonding, and physical properties (electrical, magnetic, optic etc.) of materials. Focus is given to the relationship between properties and crystal structure. Properties of Gases:1 Introduction, Kinetic Theory of Gases, Energy Distribution in Particle Systems: Maxwell–Boltzmann Distribution Law, Gas Laws, Heat Capacity, Mean Free Path, Viscosity, Thermal Conduction, Diffusion, Molecular Sizes, Properties of Gas Mixtures, Plasma – The Fourth State of Matter. Transformation Kinetics: Diffusion in Solids, Introduction, Thermodynamics, Transformation Kinetics, Reaction Rates, Kinetics of Homogeneous Reactions in Gases, Diffusion in Solids. Mechanical, Thermal and Magnetic Properties of Solids: Introduction, Total Energy of Metallic Crystals, Elasticity and Compressibility, Expansion, Heat Capacity, Magnetism. Transport Properties of Solids. Optical Properties of Solids: Introduction, Thermal Conduction, Electrical Conduction, Metallic Conductors, Insulators, Semiconductors, Optical Properties of Solids. Properties of

Liquids and Melts: Introduction, X-ray Spectra of Liquids and Melts, Models of Pure Liquids and Melts, Melting Points of Solid Metals, Density and Volume, Thermal Expansion, Heat Capacity, Transport Properties of Liquids, Diffusion, Viscosity, Thermal Conduction, Electrical Conduction.

PHY326 Nanostructure materials: properties, self-assembly and applications

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY221**

Introduction to nanotechnology and the two approaches (bottom up and top down) followed for the synthesis of nanomaterials. Synthetic methodologies which include Sol-gel, Micromulsion, CVD, PVD, Molecular beam epitaxy, Vapor (solution)-liquid-solid growth, (VLS or SLS), Spary Pyrolysis, Template based synthesis, Lithography. Various kind of Nanostructures which includes Carbon fullerenes and carbon nanotubes (CNT), Metal and metal oxide nanowires, Self-assembly of nanostructures, Core-shell nanostructures, Nanocomposites. Physical Properties of nanomaterials which includes Photocatalytic, Dielectric, Magnetic, Optical, Mechanical.

PHY327 Physics of nanoparticles and nanostructures

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **PHY 325, PHY 311**

Part one: Absorption and scattering of Electromagnetic waves from Nanoparticles based on bulk properties: Brush up: Maxwell's equations, constitutive relations, propagation of homogeneous plane waves, Reflection and Transmission through slab, Absorbance, Ripple structures, analogy between slab and a particle. Single and multiple oscillator models for bulk dielectric function of insulators, semiconductors with electronic and vibrational contributions, metals, polar and glassy materials, magnetic materials. Small particles, size parameter, quasi-static approach to polarizability of uncoated and multiply coated ellipsoidal particles, surface modes for various materials, scattering cross sections. Maxwell-Garnett theory for collection of particles, size distribution effect. Part two: Electronic Phenomena in Nanostructures: Brush up: Electronic structures and effective mass theory for bulk Si, Ge, GaAs; Excitons. Boltzmann electron transport in bulk. Electron energy states in quantum confined systems, semiconductor heterojunctions, DEG systems, Quantum Wires, Quantum dots. Transmission in nanostructures: Tunneling in planar barrier, Resonant Tunnel diodes. Ballistic transport, Landauer formula, electron transport in Quantum wave-guide structures. Single electron phenomena: electronic states in quantum dots, without and with magnetic fields, single electron tunnelling and Coulomb blockade, single electron transistor.

PHY328 Spintronics nanostructure physics and technology

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY325PHY311**

Introduction: History and overview of spin electronics, Classes of magnetic materials, the early history of spin, Quantum Mechanics of spin, the Bloch sphere, Spin-orbit interaction, exchange interaction. Spin relaxation: Spin relaxation mechanisms, Spin relaxation in quantum devices like quantum dots, the spin Galvanic effect. Spin dependent transport: Basic electron transport, Spin-dependent transport, spin dependent tunnelling, Andreev Reflection at ferro-magnet and Superconductor Interfaces: Basic theory of Andreev reflections, Point-Contact Andreev Reflection, Ferro-

magnet/Superconductors/Ferro-magnet double junctions, crossed Andreev reflections. Spintransfer torques: Spin injection: Advances in Spintronic Materials, Technology and Devices.

PHY329 Spectroscopy of nanomaterials

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY325PHY324**

Part I. Optical spectroscopy: Introduction, Spectroscopy methods, Classification on radiation, Classification of objects, Scheme of optical spectrometer Typical recorded characteristics, Color spaces, Practical application. Part II. Optical emission spectroscopy: Main types of methods, Sources for signal creation, Schemes of optical emission spectrometers, the main components of spectrometers, Features, advantages and disadvantages of glow discharge optical emission spectroscopy, Comparison of GDOES with other methods, Main control parameters, Calibration and application of standard samples, Software principles, Practical application. Part III. Energy-dispersive X-ray spectroscopy, Interaction of electron beam with matter, Main principles of the WDS and EDS spectroscopy, Construction of the X-ray detector, Main components of the detector, Types of the EDS analysis, Features of thin films investigation. Part IV. Photoelectron and Auger-electron spectroscopy, Different processes after X-ray initiation, Main principles of the XPS and UPS spectroscopy, Construction of the apparatus for XPS, Quantitative and qualitative analysis of nanomaterials including nanocomposite films, Ways for optimization of the analysis, Main principles, and features of AES spectroscopy. Part V. Raman and Fourier-transformed infra-red spectroscopy, Main vibrations of the molecules, Types of scattering, Main principles of Raman analysis and FTIR, Optical schemes of the spectrometers, Examples of practical application, Order of phase identification using standard samples and literature data.

PHY330 Thin films nanostructure and its application

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY325PHY311**

Part 1: Role of Thin films and Nanostructures in Technology and Devices; Vacuum Evaporation-Hertz- Knudsen equation, evaporation from a source and film thickness uniformity. Glow discharge and Plasmas-Plasma structure, DC, RF, and microwave excitation; Sputtering Processes - Mechanism and sputtering yield, Sputtering of alloys; Reactive sputtering. Part 2: Nucleation and Growth: Adsorption, Surface diffusion, models for 3D and 2D nucleation, coalescence and depletion, grain structure and microstructure and its dependence on deposition parameters. Role of energy enhancement in nucleation; Self-assembly: mechanisms and controls for nanostructures of 0 and 1 dimension. Part 3: Epitaxy: Structural aspects of epitaxy, homo- and hetero-epitaxy, lattice misfit and imperfections; epitaxy of compound semiconductor, theories of epitaxy, Role of interfacial layer, Artificial semiconductors, Band-gap engineering, Super lattice structures; Strained layer epitaxy. Part 4: Diffusion: types & mechanism, steady state and non-steady-state diffusion, Fick's laws, factors affecting diffusion coefficients, CVD Deposition-Thermodynamics of CVD, gas transport, growth kinetics, Plasma chemistry, plasma etching mechanisms; etch rate and selectivity, orientation dependent etching; Part 5: Growth of structures of high structural quality and multilayers of simple and complex systems: Molecular Beam Epitaxy, Atomic layer Deposition, Pulsed Laser Ablation, Ion-assisted Ion-beam Deposition, Ion-implantation Interdiffusion and Reactions in Thin Films, Diffusion during film growth, Diffusion barriers.

PHY331 Plasmonic and nanophotonics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY325PHY324**

Introduction to Nano-photonics and Plasmonic. Basis of Nano-photonics and Plasmonic. Fundamentals of Nano-photonic and plasmonic Devices. Fundamentals of Nano-photonic Fabrication. Fundamentals of Nano-photonic Systems. Fundamentals of Nano-Bio-photonics.

PHY341 Electronics I

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY211**

Describe the meaning of the key electrical variables (charge, voltage, current and power). Apply fundamental circuit laws (Ohms law, Kirchhoffs laws) and key electrical circuit theorems (series and parallel elements, voltage/current divider, Thevenins and Nortons theorems, superposition, nodal and mesh analysis) to predict the behaviour of DC and AC resistive circuits. Analyze RLC circuits in the steady-state and transient conditions using differential equations and phasor analysis. Explain the concept and characteristics of resonance in RLC circuits. Analyze simple circuits using diodes, including half- and full-wave rectifier circuits. Apply simple models of bipolar and field effect transistors, and operational amplifiers, to predict the behaviour of simple amplifier circuits. Explain and model the frequency-dependent behaviour of circuits containing a single capacitor or inductor. Explain the principles of operation and key performance characteristics of AC and DC motors. Explain the operation of the circuits using transistors in switching mode to achieve speed control of a DC motor. Demonstrate practical skills in the construction and testing of simple electrical and electronic circuits.

PHY361 Fundamentals of Energy Systems

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY111**

Topics include Energy Sources & World Energy Status: Energy Sectors: Domestic, Transportation, Agriculture, Industry Sector, Energy Scenario, World Energy Present Situation, Availability of Conventional & Non-Conventional Energy Resources. Conventional Energy Sources: Fossil Fuel, Hydro Resources, Nuclear Resources, Coal, Oil, Gas, Thermal Power Stations, Comparison of various conventional energy systems, their prospects and limitations, Advantages and Disadvantages of Conventional Energy Sources. Non-Conventional Energy Sources: Solar Energy, Wind Energy, Energy from Biomass & Biogas, Ocean Thermal Energy Conversion, Tidal Energy, Geothermal Energy, Hydrogen Energy, Fuel Cell, Magneto Hydro-Dynamics Generator Advantages & Limitations of Non-Conventional Energy Sources. Fluid Properties and Classification of Fluid: Definition of Fluid, Distinction between solids & fluid and liquid & gas fluid continuum, Mass density, Specific Volume, Viscosity, Newton's law of viscosity, Newtonian and Non-Newtonian Fluids, Ideal and Real fluids, Steady & Unsteady Flow, Uniform & Non-Uniform Flow, Laminar & Turbulent Flow, Compressible & Incompressible Flow, Surface tension, Definitions, units, and dimension. Fluid Pressure & Its Measurement: Definition of pressure, units and dimensions, Pressure at a point, Pascal's law. 4 Hydrostatic pressure law. 5 Absolute and Gauge pressure. 6 Measurement of pressure, Simple Manometer & Differential Manometer theory and problems, Mechanical Pressure Gauge. Kinematics of Fluid Flow: Description of fluid flow, Lagrange and Eulerian approaches, Definition of path line, streamline, streak line, stream tube, Acceleration of flow. Dynamics of Fluid Flow: Concept of Inertia force and other forces causing motion, Derivation of Euler's

equation and Modification of Bernoulli's equation, problem on Bernoulli's equation without and with losses. Flow Measurements: Flow through Orifices; classification, Hydraulic Co-efficient of an Orifice and relation between them, Equation for Co-efficient of velocity, problems, Flow Through Pipes, Venturi Meter.

PHY362 Energy Conversion System

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **- - -**

Students learn the following subjects: Elements of Electro-Mechanical energy conversion: Salient aspects of conversions, Energy- Balance, Magnetic-field System; Energy and Co-energy, A Simple Electromechanical System, Energy in Terms of Electrical Parameters, Rotary Motion, Dynamic Equations, and system-model of a simple system. D.C. Generators: Simple Loop Generator, Practical Generator, Yoke, Pole Cores and pole shoes, Pole Coils, Armature Core, Armature Windings, Commutator, Brushes and Bearings, Armature windings, Measurement of Generator Efficiency. 15 Irons Loss in Armature. 1 Hysteresis Loss (Wh) Total Loss in a D.C. Generator, Generator characteristics: Characteristics of D. C. Generators, separately excited Generator. D. C. Motor: Motor Principle, Comparison of Generator and Motor Action, Significance of the Back e.m.f, Voltage Equation of a Motor, Condition for Maximum power, Torque, Armature Torque of Motor, Shaft Torque, Speed of D. C. Motor, Speed Regulation, Torque and Speed of D. C. Motor, Motor Characteristics, Characteristics of Series Motors, Characteristics of Shunt Motors, Compound Motors, Performance Curves, Series Motor, Comparison of Shunt & Series Motors, Power Stages. Speed Control of D.C. Motors: Factors Controlling Motor Speed, Speed Control of Shunt motors, Variation of flux or Flux Control Method, Armature or Rheostatic Control Method, Voltage Control Method, Speed Control or series Motors, Flux Control Method, Variable Resistance in series with motor, Measurement of Motor Efficiency. Transformer: Working principle of a Transformer, Transformer Construction, Core-type Transformers, Shell-type Transformers, Elementary Theory of an ideal Transformer, D.M.F. Equation of transformer, Voltage Transformation Ratio (K), Transformer with losses but no magnetic Leakage, Transformer on No-load, Transformer on load, Transformer with winding resistance but no Magnetic leakage, Magnetic leakage, Transformer with resistance and leakage reactance, Estimation of Transformer Efficiency (at Full Load &Actual Load), Transformer three phase. Induction Motor: Classification of A.C. Motors, Induction Motor: General Principle, Construction, Squirrel-cage rotor, Phase-wound rotor, Production of Rotating field, Three-Phase supply, Mathematical proof, why does the rotor rotate? Slip, Frequency of rotor current, Starting Torque of a squirrel-cage motor, Starting Torque of a slip-ring motor, Torque/Speed Curve, Current /speed curve of on induction motor. Single-Phase Motors: Types of single-phase motors, Single-phase induction motor, Double-field revolving Theory, making single-phase induction motor self-starting, Types of capacitor-start motors, 1 Single-voltage, externally reversible motors, single-voltage, non-reversible type, Speed control of D.C. Motors, Transformer, Induction Motor.

PHY363 Energy and Environment

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Students Learn the Following Subjects: Energy & Environment Balance. Introduction to Sources of Energy, Overview of Environmental Effects, Various Forms of Energy Extraction and Consumption. Energy. Patterns of Energy Consumption, The Laws of Energy Conversion, Work, Heat, And Internal Energy, Qualitative Presentation of Thermodynamic Barriers to Energy Use. Energy and The Industrial Society. Energy and Growth, Energy Flow in an Industrial Society, Primary Fuels: Wood, Coal, Oil, Natural Gas. Electrical Energy. Generation of Electrical

Energy, Transmission of Electrical Energy, End Uses of Electrical Energy. Energy and Air Pollution. Sources of Air Pollution, Effects of Air Pollution, Controlling Air Pollution, Effects of Energy on Climate, Co2 and the "Greenhouse Effect", Energy Transport and The Environment; Pipelines, Tankers, Oil Spills, Energy-Related Water Demand. Energy and Society. Renewable Energy Flows and The Problems of Matching Them with End Use Requirements, Energy Inequity and Energy Conflicts Energy Versus the Environment, Roles of Government and Private Industry.

PHY364 Solar Thermal Energy I

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **PHY111**

Students learn the following subjects: Basics in Solar Energy Systems: Different types of Renewable Energy Sources, Sun as a Source of Energy, Solar Radiation. Extra Terrestrial at Earth's Surface – Horizontal, Tilted Surface, Estimation of Radiation Alternation of Solar Radiation by Atmosphere, Effect of Orientation of Receiving Surface. Basic Suns-Earth Angles: Angle of Latitude, Declination Angle, Hour Angle, Inclination Angle, Zenith Angle, Solar Azimuth Angle, Tilt Angle, Surface Azimuth Angle, Angle of Incidence, Local Solar Time. Solar Radiation: Solar Radiation Data, Estimation of Monthly Average, Daily Total Radiation on Horizontal Surface, Estimation of Monthly Average, Daily Diffuse Radiation on Horizontal Surface, Monthly Average, Daily Global Radiation on Tilted Surface. Measurement of Solar Radiation: Measurement of Solar Radiation, Pyranometer, Pyrheliometer, Sunshine Recorder, Radiation Characteristics of Opaque Materials, Radiation Transmission through covers and Absorption of Collectors. An Overview of Thermal Applications: Devices for Thermal Collection and Storage, Thermal applications. Liquid Flat-Plate Collectors (FPC): Characteristic Features of FPC, Performance Analysis, Transmissivity - Absorptivity Product, Overall, Loss Coefficient and Heat Transfer Correlations, Collector Efficiency Factor, Effects of Various Parameters on Performance, Advantages of Flat Plate Collector, Alternatives to the Conventional Collector. Solar Air Heaters & Water Heater: Performance Analysis of Solar Air Heater, Types of Air Heaters, Collector with Non-Porous Absorber, Collector with Porous Absorber, Testing Procedure of Solar Air Heater, Application of Solar Air Heater, Solar Water Heating System: Thermosiphon & Forced Flow.

PHY365 Bio-Energy I (Biochemical Conversion Systems)

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

The course provides an overview of Bio Energy. Students learn the following subjects: Basics in Biomass Study: Biomass- types and its advantages and drawbacks, Conversion Mechanisms, Fuel Assessment Studies. Biomethanation: Microbial systems, Phases in Biogas Production, Parameters Affecting Gas Production, Biogas Plants: Types, Design, Constructional Details and Comparison, Factors Affecting the Design. Methods for Maintaining Biogas Production: Insulating the Gas Plant, Composting, Hot Water Circulation Use of Chemicals, Solar energy systems. Commissioning and Management of Biogas Plant: Commissioning and Management of Biogas Plant, Community Plant, Biogas Appliances, Effect of Biogas on Engine Performance, Socio-Economic Aspects of Biogas, Cost-Benefit Analysis of Biogas Plant. Reactors: Immobilized Reactors, UASB Reactor, Fixed Film, Hybrid, Bi-Phasic Reactor. Economics and Environmental Aspects: Energy Effectives and Cost Effectiveness, History of Energy Consumption and Cost, Economic and competitive

issues for biogas energy, Policy, and market interventions (subsidies, credits, carbon markets etc.), Environmental Aspects of Bio-Energy Conversion. Muncipal & Industrial Waste to Energy Conversion: Solid Waste, Waste Disposal, Industrial Solid Wastes, Hazardous Waste Management. Biofuel: Ethanol and Methanol production from Cellulosic Biomass, Biodiesel Production from Non-Edible Oil Seeds.

PHY366 Energy Storage System I

2 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **PHY361**

The course provides an overview of the Energy storage system. Students learn the following subjects: ENERGY STORAGE. Need of energy storage, Different modes of Energy Storage, Potential Energy, Kinetic Energy & Compressed Gas System, Electrical and magnetic energy storage, Chemical Energy storage, Hydrogen for energy storage, Solar Ponds for energy storage. ELECTROCHEMICAL ENERGY STORAGE SYSTEMS. Primary & Secondary Batteries, Solid-State and Molten Solvent Batteries, Lead acid batteries. Nickel Cadmium Batteries, Advanced Batteries. MAGNETIC AND ELECTRIC ENERGY STORAGE SYSTEMS. Superconducting Magnet Energy Storage (SMES) Systems, Capacitor and Batteries.

PHY367 Energy Management

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

The course provides an overview of Energy Management. Students learn the following subjects: INTRODUCTION. Energy & Sources of energy, Energy consumption and GDP, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan. ENERGY AUDIT. Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving opportunities, Economic analysis, and life cycle costing. ENERGY CONSERVATION. Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Data base for energy management, Energy conservation through controls, Computer aided energy management, Program organization and methodology. ENERGY USES. Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes. Energy Economy interaction.

PHY371 Astronomy and Astrophysics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **PHY111PHY211**

The course provides an overview of the Electronics. Students learn the following subjects: Humanity and the Cosmos. Tools of the Astronomer. The Solar System. Stars and Their Properties. Galaxies and Cosmology.

PHY400 Physical Computing

3 Cr. Hrs. = (*1* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Physical computing, microcontrollers, bread boarding, Arduino, programming, digital input, digital output. Reading: Physical Computing. Electricity and Programming: concepts, Ohm's Law, circuit diagrams, soldering, switch making variables, organization. Analog Input: transduction, transducers, resistors, variable resistors, types of variables, programming review. Programming: loops, for loops,

functions, timing, intro to Processing. Analog Output: variable output using PWM, using servos and servo libraries. Programming II: drawing with variables, mouse interaction, conditionals (bounce). Motors: DC, high current, steppers, control, relays, transistors, steppers, H-bridge.

PHY411 Computational physics in nanoscience

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **CSE014PHY311PHY324**

Review of Quantum Physics. Quantum Chemistry. Molecular Biology. Condensed Matter Physics. Quantum wells, Dot, and Wire. Nanostructure Electronic Properties. Plasmon. Quantum Hall Effect.

PHY412 Physics of semiconductor nanostructure

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **PHY311PHY325PHY326**

The course deals with the physics and applications of semiconductor nanostructures, i.e., low-dimensional systems giving rise to quantum confinement effects for electrons and holes in one, two or three dimensions. The following subjects will be treated: First-principles calculations, band discontinuities. Hetero-structures, envelope-function method. Two-dimensional systems: quantum wells, superlattices, hetero interfaces. Optical properties. Absorption and emission, interband and intersubband transitions in quantum wells, semiconductor laser. Confined excitons and polaritons. Transport properties. Tunnelling and negative differential resistance, tunnelling diode, resonant tunnelling in double-barrier structures. Effects of electric and magnetic fields. Quantum Hall effect, integer and fractional. One- and zero-dimensional systems: quantum wires and quantum dots, electronic levels, transport and optical properties, correlation effects. Photonic confinement (semiconductor microcavities and photonic crystals, short mention). Semiconductor cavity QED and Jaynes Cummings model.

PHY413 Advanced characterization techniques of nanomaterials

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **PHY311PHY325PHY326**

This course aims at teaching the students underlying principles of analytical techniques that are commonly used for the evaluation of bulk properties as well as nanomaterials. These include surface analysis technique FTIR spectroscopy; optical properties evaluation by UV-Vis spectroscopy and ellipsometry techniques; crystallographic phase identification by XRD; microstructure investigation by Electron microscopy (SEM and HRTEM); surface area analysis by BET surface area analyzer; magnetic properties by VSM and particle size- surface charge analysis by DLS and seta potential techniques. The course is planned in the form of theoretical and experimental modules for each analysis technique.

PHY414 Nanofabrication

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **PHY311PHY325PHY326**

Introduction to Micro- and Nanofabrication. Fundamentals of techniques used in Nanofabrication. Reviewing Physical and Chemical Vapor Deposition. Treatments of Substrate Materials. Treatments of Thin-Film materials.

PHY415 Nanolithographic techniques

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **PHY311PHY325PHY326**

Lithography: Substrate Cleaning and Preparation, Spin Coating, Photomasks, UV Light Sources, Contact Mask Lithography, Projection Photolithography, Basic Properties of Photoresists, Patterning by

Lithography, Laser Interference Lithography, Resolution Enhancement Techniques, Extreme-UV Lithography, Nonoptical Lithography. Wet Chemical and Plasma Etching: Basic Principles of Wet Chemical Etching, Wet Chemical Etch of some Selected Materials like Silicon Dioxide Etch, Silicon Nitride Etch, Silicon Etch, Aluminum Etch, Copper Etch and Titanium Etch and so on. Plasma Etching Basic Construction of a Plasma Etcher, Free Radicals and Ions in a Plasma and Their Roles Inductively Coupled Plasma Etching Substrate Temperature Silicon Etching. Doping, Surface Modifications, and Metal Contacts: Thermal Budget, Doping by Thermal Diffusion, Ion Implantation, Thermal Oxidation of Silicon, Metal Contacts to Semiconductors. Metrology for Device Fabrication: Semiconductor Device Fabrication Metrology, Interconnect Metrology.

PHY416 Electronics II

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY341**

Digital Electronics I. Number Systems- decimal, binary, hexadecimal, octal and BCD. Logic Gates, Boolean Algebra and Truth Tables. Combinational Logic: Introduction and Combinational Logic Circuit Analysis, Canonical and Standard Forms, Use Boolean Algebra to simplify Boolean expressions, Logic minimization using Karnaugh Map, Combinational Logic Circuit Design. Applications of combinational logic. Arithmetic circuits: Half Adder, Full Adder, 2-bit Adder, 2-bit Subtractor. Comparators. Encoders and Decoders: Priority Encoder, BCD to 7 segment decoders. Multiplexers and Demultiplexers: Multiplexers, Demultiplexers. Parity Checkers. Digital Electronics II. Latches and Flip-Flops. SR NAND Latch. SR NOR Latch. D Latch. D Flip Flop. JK Flip Flop. Counters. Ripple Counter. Truncated Ripple Counter. Synchronous sequential circuits. Synchronous Counter Design. State reduction using Implication Table. Shift Registers. Ring Counter. Johnson Counter. Programmable Logic Devices. Data Conversion Circuits. Digital to Analog Converters (DAC). Analog to Digital Converters (ADC). Digital Electronics Circuits. Stepper Motor circuit. 12H/24H Digital Clock circuit. BCD to Seven Segment Display circuit. Overview: Nano devices, Nano materials, Nano characterization. Definition of Technology node, Basic CMOS Process flow. MOS Scaling theory, Issues in scaling MOS transistors: short channel effects, Description of a typical 65 nm CMOS technology. Requirements for Non classical MOS transistor. MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k. Interface states, bulk charge, band offset, stability, reliability - Qbd high field, candidates, CV and IV techniques. Metal gate transistor: Motivation, requirements, Integration Issues. Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot. SOI – PDSOI, FDSOI and Ultrathin body SOI - double gate transistors, integration issues. Vertical transistors - FinFET and Surround gate FET. Metal source/drain junctions - Properties of schotky junctions on Silicon, Germanium, and compound semiconductors -Work-function pinning. Germanium Nano MOSFETs: strain, quantization, Advantages of Germanium over Silicon, PMOS versus NMOS. Compound semiconductors - material properties, MESFETs Compound semiconductors MOSFETs in the context of channel quantization and strain, Hetero structure MOSFETs exploiting novel materials, strain, quantization.

PHY417 Nanoelectronics device and materials

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY341PHY416**

Overview: Nano devices, Nano materials, Nano characterization. Definition of Technology node, Basic CMOS Process flow. MOS Scaling theory, Issues in scaling MOS transistors: short channel effects, Description of a typical 65 nm CMOS technology. Requirements for Non classical MOS transistor. MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k. Interface states, bulk charge, band offset, stability, reliability - Qbd high field, candidates, CV and IV techniques. Metal gate transistor: Motivation, requirements, Integration Issues. Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot. SOI – PDSOI, FDSOI and Ultrathin body SOI - double gate transistors, integration issues. Vertical transistors - FinFET and Surround gate FET. Metal source/drain junctions - Properties of schotky junctions on Silicon, Germanium, and compound semiconductors -Work-function pinning. Germanium Nano MOSFETs: strain, quantization, Advantages of Germanium over Silicon, PMOS versus NMOS. Compound semiconductors - material properties, MESFETs Compound semiconductors MOSFETs in the context of channel quantization and strain, Hetero structure MOSFETs exploiting novel materials, strain, quantization.

PHY419 Graduation Project

4 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***4*** LAB + ***0*** OTH) – SWL = ***210*** – ECTS = ***8***

Prerequisite **- - -**

Literature survey. Data collection. Finding a research question. Establishing the first prototype.

PHY421 Solar Photovoltaic Energy Conversion II

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY323**

Students learn the following subjects: Solar Cell Fabrication Technology: Preparation of Metallurgical, Electronic & Solar Grade Silicon, Production of Single Crystal, Multicrystalline, Gallium Arsenide, Copper Indium Diselenide, Amorphous Solar Cell, Wafering & Doping, Thin-Film Modules-method of Manufacture, Procedure of Masking, Photolithography & Etching, Role of Nanotechnology in Solar Cell, Module Lamination & Fabrication. Solar PV System: Classification, Stand-Alone Solar PV System, Grid Interactive Solar PV System, Hybrid Solar PV System, Battery technology, Introduction : Basic Concepts, Components of Battery, Operation of Battery, Battery Characteristics, Classification of Batteries, Classical batteries : Lead Acid, Nickel Cadmium, Zinc Manganese dioxide, Inverter, Classification of Inverter, Single Phase Series Inverter, Single Phase Full Bridge Inverter, Single Phase Inverter Output Voltage Control, Single Pulse Width Modulation, Multiple Pulse Width Modulation. Smart Grid Technology: Evolution of Electric Grid, Concept of Smart Grid, Definition of Smart Grid, Need of Smart Grid, Functions Smart Grid, Opportunities and Barriers Smart Grid, Difference between Conventional Grid and Smart Grid, Concept of Resilient Grid and Smart Grid, Role of Smart Meter in Smart Grid, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR),

Smart Sensors, Smart Grid Life Cycle, Regulatory & Cost Recovery, Strategy & Planning, Technology Integration, Business Process Readiness, Compliance & Risk Management. Solar PV Applications: Grid Interactive PV Power Generation, Water Pumping, Lighting, Medical Refrigeration, Village Power, Telecommunication and Signaling.

PHY422 Solar Selective Materials

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **PHY111**

The course provides an overview of solar selective materials. Students learn the following subjects: Characterization of Selective Surfaces. Description of Types of Absorbers. Intrinsic or "mass absorbers." Semiconductor-metal tandems. Multilayer absorbers. Metal-dielectric composite coatings. Surface texturing. Selectively solar-transmitting coating on a blackbody-like absorber. Temperature Range of Absorber Materials. Mid-temperature selective surfaces (100ºC < T400ºC). High-temperature selective surfaces (T>400ºC).

PHY423 Nano-photonics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **PHY221**

Introduction to Nano-photonics: Modern optical science and technology and the diffraction limit – Breaking through the diffraction limit – Nano-photonics and its true nature. Basis of Nano-photonics: Optical near fields and effective interactions as a base for Nano-photonics – Principles of operations of Nano-photonic devices using optical near fields – Principles of nanofabrication using optical near fields. Fundamentals of Nano-photonic Devices: Excitation energy transfer – Device operation: Nano-photonic AND gate & nano-photonic OR gate – Interconnection with photonic devices – Room temperature operation. Fundamentals of Nano-photonic Fabrication: Adiabatic nanofabrication – Nonadiabatic Nano-fabrications: near field optical CVD and near field photolithography – Self assembling method via optical near field interactions – Regulating the size and position of nanoparticles using size dependent resonance – Size controlled, position controlled and separation-controlled alignment of nanoparticles. Fundamentals of Nano-photonic Systems: Introduction – Optical excitation transfer and system fundamentals – Parallel architecture using optical excitation transfer – Interconnections for Nano-photonics – Signal transfer and environment – tamper resistance – Hierarchy in Nano-photonics and its system fundamentals.

PHY428 Practical Training and Internship

4 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***4*** LAB + ***0*** OTH) – SWL = ***210*** – ECTS = ***8***

Prerequisite ***- - -***

The course provides the student with an opportunity to gain knowledge and skills from a planned work experience in the student's chosen career field. In addition to meeting Core Learning Outcomes, jointly developed Specific Learning Outcomes are selected and evaluated by the Faculty Internship Advisor, Work-site Supervisor, and the student. Internship placements are related to the student's program of study and provide learning experiences not available in the classroom setting. Internships provide entry-level, career-related experience, and workplace competencies that employer's value when hiring new employees. Internships may also be used as an opportunity to explore career fields. Students must meet with an Internship Education Program Advisor prior to registering.

PHY461 Solar Thermal Energy II

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY364**

Students learn the following subjects: Concentrating Collectors: Flat-

plate Collectors with Plane Reflectors, Tracking lodes & Analysis of Cylindrical Parabolic Collector, Compound Parabolic Collector (CPC), Paraboloid Dish Collector, Central Receiver Collector. Other Solar Thermal Devices: Solar still basin & multiple effect, Solar Cookers, Box Type, Paraboloid Dish, Scheffler Type, Solar Dryers: Cabinet Type Dryer & Indirect Driers, Solar Ponds & its Analysis. Other Applications of Solar Energy: Solar Distillation, Solar Pumping, Solar Cooking, Solar Cooling & Refrigeration. Thermal Energy Storage: Sensible Heat Storage, Latent Heat Storage, Thermo-Chemical Storage. Applications: Thermal energy storage: various methods and applications, Solar ponds: thermal applications, Thermal Power Conversion, Solar Cooling and Heating, Solar Desalination, Drying, Solar Pumping.

PHY462 Bio-Energy II (Thermo-Chemical Conversion of Biomass)

2 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***105*** – ECTS = ***4***

Prerequisite **PHY365**

Students learn the following subjects: Biomass: Biomass Composition, Properties of Biomass, Thermal degradation: Steps, Arrhenius law, Kinetics, Gas Producers. Gasification: Principles of Gasification, Pre-Treatment of Biomass, Physical Treatment: Mechanically Grinding &Chipping, Moisture Removing or Adding, Application of Binding Agent, Steaming, Torrefaction, Chemistry of Gasification, Types of Gasifiers and Zones, Updraft Gasifier – Principles – Design – Application, Downdraft Gasifier - Principles – Design – Application, Cross Draft Gasifier - Principles – Design – Application, Open core Gasifier - Principles – Design – Application, Fluidized Bed Gasifier - Principles – Design –Application – Models. Gasifier Applications: Engine system: Requirements, Thermal application: System, Requirements. Combustor: Wood Burning Stoves, Principle of Wood Burning Stoves, Design: Wood Burning Stoves. Pyrolysis: Pyrolysis Plants, Principle of Pyrolysis Plants, Products Recovery from Pyrolysis Plants. Cogeneration: Principle & Classification (Topping Cycle, Bottoming, Cycle, Combined cycle, Rankine Cycle) of Cogeneration.

PHY463 Energy Storage System II

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY366**

The course provides an overview of the Energy storage system. Students learn the following subjects: SENSIBLE HEAT STORAGE (SHS). Mediums for SHS, Stratified storage systems, Rock-bed storage systems, Thermal storage in buildings, Energy storage in aquifers. LATENT HEAT THERMAL ENERGY STORAGE PHASE. Change Materials (PCMs): Selection criteria of PCMs, Solar thermal LHTES systems, Energy conservation through LHTES systems, LHTES systems in refrigeration and air conditioning systems, Areas of Application of Energy Storage, Food preservation, Waste Heat Recovery, Solar Energy Storage, Green House Heating, Power Plant Applications, Drying and Heating for Process Industries. FUEL CELL. Introduction to Technology Overview, Critical Functions of Cell Components, Fuel Cell Types, Characteristics and Advantages/Disadvantages of Fuel Cell, Fuel Cell Calculations, Fuel Processing Calculations, Applications of Fuel Cells.

PHY464 Introduction to Electric Power Systems

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **PHY313PHY341**

Students learn the following subjects: fundamentals of energy-handling electric circuits, power electronic circuits such as inverters, and electromechanical apparatus. modeling of magnetic field devices and

description of their behavior using appropriate models. simplification of problems using transformation techniques. analysis of power electric circuits, magnetic circuits, and elements of linear and rotating electric machinery. use of lumped parameter electro-mechanics to understand power systems. models of synchronous, induction, and DC machinery. the interconnection of electric power apparatus and operation of power systems.

PHY465 Wind Energy

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **PHY111PHY211**

The course provides an overview of Wind Energy. Students learn the following subjects: Basics of Wind: Causes of wind, Types of Winds, Planetary or Permanent Winds, Trade Winds, Westerlies Winds, Polar Winds, Periodic Winds, Sea Breeze Winds, Land Breeze Winds, Monsoon Winds: Summer, Winter, Local, Local & Regional Wind System, Meteorology of Wind: Global Circulation, Forces influencing Wind – Pressure Gradient Force &Coriolis Force, Power in the Wind. Wind Measurement Techniques: Measurement & Instrumentation, Wind Data Presentation, Power Law Index, Betz Constant, Terrain value, Wind data Characterization, Mean Wind Speed, Wind Speed Distribution: Diurnal Pattern, Depression& Anti-Cyclones and Annual Pattern, Wind Turbulence Characteristics: Short-term fluctuations & Long-term fluctuations, Wind Direction Distribution, Wind Shear, Wind Data Statics, Weibull, Rayleigh & Normal Distributions. Wind Resource Assessment: Atmospheric Boundary Layer, Atmospheric Stability, Wind Power Conversion, Wind Power Estimation, Site Survey & Analysis. Windmill Site Selection & Micro Siting Aerodynamics & Windmill Blade. Wind Energy Conversion: Wind Mill, Basic Components of Wind Mill Conversion System, Types of Wind Mills – Based on: Application, Wind Flow Direction, Tower Type & Height, Rotor, Controls, Axis, Number & Types of Blades, Speed, Inventor & Make, Development of Wind Turbine, Wind Turbine Terminology, Tip Speed Ratio, Tip Loss, Lift / Drag / Axial Thrust, Slip Stream Theory, Rotor Solidity, Power & Torque co-efficient, Co-efficient of Performance, Efficiency, Wind Turbine Performance Analysis.

PHY466 Other Renewable Energy Sources

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **PHY111PHY211**

Students learn the following subjects: Geothermal Resources: Hydrothermal Resources, Geo-pressured Resources, Hot Dry Rock Resources, Magma Resources, Advantages & Disadvantages of Geothermal Energy. Applications of Geothermal Energy: Electric Power Generation, Industrial Process Heat, Space Heating for various kinds of buildings. Tidal Energy: Origin & Nature of Tidal Energy, Tidal Energy Technology, Advantages &Limitations of Tidal Energy, Environmental Impacts. Wave Energy: Energy & Power in Waves, Wave Energy Technology, Heaving Float Type, Pitching Type, Heaving & Pitching Float Type, Oscillating Water Column Type, Surge Devices, Advantages & Disadvantages of Wave Energy. Ocean Thermal Energy: Ocean Thermal Conversion Technology (OTEC), Open Cycle OTEC System, Closed or Anderson OTEC System, Environmental Impacts.

PHY467 Energy Efficiency in Building and Ecbc

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

The course provides an overview of Energy Efficiency in Building. Students learn the following subjects: Energy Conservation in Buildings: Criticality of resources (Energy & Water), Heat Loss and Heat Gain and its evaluation, Thermal Comfort Improvement Methods, IAQ Requirements, Electrical Energy Conservation, Opportunities and Techniques for energy conservation in Buildings. Thermal Behaviour of

Building: Orientation and Planning for Environment, Principles of Heat, Thermal Insulation, Humidity and Condensation, Humidity and Condensation, Admittance Method, Building energy Simulation, Load Calculation. Efficient Lighting and Daylighting: Principles of Lights, Artificial Lighting, Natural Lighting, Lighting and Visual ability, Light sources and Luminaries, Lighting System Design, Impacts of Lighting efficiency, Installed Interior and Exterior Lighting Power. Energy Conservation in Air Conditioning System: Energy Conservation in pumps/fan/ blowers, Refrigerating machines, Heat Rejection Equipment, Energy efficient motors, Insulation. Indoor Environmental Requirement and Management: Thermal Comfort of Building, Air Conditioning Requirement, Illumination Requirement, Auditory Requirement, Energy Management Options. Service Hot Water & Pumping: Mandatory Requirements of Service Hot Water, Solar Water Heating, Equipment Efficiency, Supplementary Water Heating System, Piping Insulation, Swimming Pools.

PHY495 Special Topic

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***1*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Advanced topics related to field.

Department of Mathematics

MAT110 Basic Mathematics

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite - - -

Basic nutritional definitions and terms - Relationship between nutrition and health- Importance of balanced diet- Signs of good nutrition- Food Pyramids-Basic energy and macronutrients and micronutrients needs. Classes of macronutrients and micronutrients and deficiency problems.

MAT111 Mathematics I

3 Cr. Hrs. = (*3* LCT + *1*TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

The calculus part covers functions, Properties of functions, Type of functions, Invers function, Limits, Continuity, Derivatives, Rate of change, Higher derivatives, Applications of differentiation: L'Hopital's Rule, Mean Value Theorem, Related rates, Maximum and minimum. The Linear Algebra part covers Systems of Linear equations, Theory of matrices, Determinants, and Examples and Applications in Systems of Equations, Economics, Physics, Geometry, and Chemistry.

MAT112 Mathematics II

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

The calculus part covers Riemann integration, Techniques of integration, Improper integrals, Multiple Integrations, Applications of integration. The algebra part covers, Mathematical logic, Sets and Relations, Techniques of proof, Complex numbers.

MAT113 Pre-Calculus

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Sets and relations, Properties of Real Numbers, polynomial, rational, exponential, logarithmic and trigonometric functions, and their graphs.

MAT121 Dynamics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Particles Dynamics in Two and Three Dimensions (Constrained motion), Motion of a System of Particles (Linear Momentum of a System of Particles), Angular Momentum, Composition of Angular Velocities, Moving Axes, Orthogonal Transformations, Instantaneous Axis of Rotation, and Instantaneous Center of rotation.

MAT122 Statics

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Vector algebra, Moment of force, Couples, Equivalent forces and couples, Equilibrium of rigid body in two dimensions, Friction, Center of gravity, relative motion, Impulsive forces, resisted motion, Simple harmonic motion, Changing mass problems, Projectile motion under gravity.

MAT123 Mechanics

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Vector algebra, Moment of force, Couples, Equivalent forces and couples, Equilibrium of rigid body in two dimensions, Friction, Center of gravity, relative motion, Particles dynamics in two and three dimensions (Constrained motion), Motion of a system of particles (Linear momentum of a system of particles), Angular momentum, Composition of angular velocities, Instantaneous axis of rotation and instantaneous center of rotation.

MAT131 Probability and Statistics I

3 Cr. Hrs. = (2 LCT + 2 TUT + 1 LAB + 0 OTH) - SWL = 195 - ECTS = 6

Prerequisite ---

Sets, Techniques of counting, Probability spaces, Independence and dependence, Conditional probabilities, Random variables, Expectation, variance, and moments, Moment generating functions, Independence of random variables, Conditional expectation, Discrete and continuous distributions, Joint and marginal distributions

MAT211 Mathematics III

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

First order differential equations: Basic concepts, Separable, Exact, Linear. Second order differential equations: Homogeneous linear ODEs, Homogeneous linear ODEs with constant coefficients, Nonhomogeneous ODEs. Higher-Order Linear differential equations: Homogeneous linear ODEs, Homogeneous linear ODEs with constant coefficients.

MAT212 Linear Algebra

3 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Matrices and Gaussian elimination, Vector Spaces, Vector calculus, Orthogonality, Determinants, Eigenvalues and Eigenvectors, Positive definite matrices, Computations with matrices, Linear programming, and Game theory.

MAT214 Pure Mathematics for Business

4 Cr. Hrs. = (*3*LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

Functions, Types of Functions, and Graphs. Limits, continuity, and Differentiation. Sequences and Series. Metrics and Determinants. System of Linear Equations. Linear Programming. Techniques Integration.

MAT215 Mathematics of Finance

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0*LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Topics covered are Functions and Types of Functions. Limits, Sequences, Series, and Applications (Interest Rates and Annuities). Matrices, Determinants, and linear System of Equations. Leontief Economic models. Linear Programming.

MAT216 Introduction to Risk and Insurance

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Topics covered include Part 1: Risk and its Treatment. Basic concepts

of risk. Risk management. Part 2: The insurance industry. The insurance Mechanism. Types of insurance. Part 3: Law and the insurance contracts. Fundamental Legal principles. Analysis of insurance contracts. Part 4: Government Regulation of insurance. Government Regulation of insurance. Characteristics of the insurance industry in Egypt and developing countries. Part 5: Morality tables life insurance premiums. Mortality tables. Pure endowment and commutation symbols. Life annuities. Life insurance. Annual and gross premiums. Moments and products of inertia, the theorem of parallel and perpendicular axes, Angular momentum of rigid body about a fixed point and fixed axes, Newton's laws of motion, Conservation of angular momentum, Conservation of energy, Three dimensional rigid body (Euler's equations of motion, Motion of rigid body under no forces, Eulerian angles, Motion of a symmetrical top, General three dimensional rigid body motion, Accelerated coordinate system.

MAT221 Rigid Body Dynamics

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Moments and products of inertia, the theorem of parallel and perpendicular axes, Angular momentum of rigid body about a fixed point and fixed axes, Newton's laws of motion, Conservation of angular momentum, Conservation of energy, Three dimensional rigid body (Euler's equations of motion, Motion of rigid body under no forces, Eulerian angles, Motion of a symmetrical top, General three dimensional rigid body motion, Accelerated coordinate system.

MAT231 Probability and Statistics II

3 Cr. Hrs. = (2 LCT + 1 TUT + 2 LAB + 0 OTH) - SWL = 195 - ECTS = 6

Prerequisite MAT131

Normal distribution, Law of large numbers, Central limit theorem, Distributions derived from Normal distribution: Chi-squared, Student-t, and F distributions, Statistical estimation, Point estimation, Confidence intervals, Test of hypotheses, Fitting straight lines, Analysis of variance, Stochastic models, Poisson processes.

MAT232 Statistics and Data Analysis

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **- - -**

Examining relationships between two variables using graphical techniques, Simple linear regression, and correlation methods. Producing data using experiment design and sampling. Elementary probability and the basic notions of statistical inference including confidence interval estimation and tests of hypothesis. One and two sample t-tests, one-way analysis of variance, inference for count data and regression. Methods of counting and probability, Random variables and their probability distribution, Special probability distributions, Sampling distributions.

MAT312 Differential Equations

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***150*** – ECTS = ***6***

Prerequisite **MAT112**

First order differential equations: Basic concepts, Separable, Exact, Linear. Second order differential equations: Homogeneous linear ODEs, Homogeneous linear ODEs with constant coefficients, Nonhomogeneous ODEs. Higher-Order Linear Differential Equations: Homogeneous linear ODEs, Homogeneous linear ODEs with constant coefficients, Partial differential equations, and Laplace transforms.

MAT313 Differential Equations and Numerical Analysis

4 Cr. Hrs. = (*3* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite **MAT112**

First order differential equations: Basic concepts, Separable, Exact, Linear. Second order differential equations: Homogeneous linear ODEs, Homogeneous linear ODEs with constant coefficients, Nonhomogeneous ODEs. Higher-Order Linear Differential Equations: Homogeneous linear ODEs, Homogeneous linear ODEs with constant coefficients, Solution of equation by iteration, Interpolation Numeric integration and differentiation, Linear system (Solution by iteration), Method for first ODEs, Multistep Method.

MAT314 Discrete Mathematics

4 Cr. Hrs. = (*3* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite **- - -**

Sets, Relations, Functions, Techniques of proof, Enumerative Combinatorics, Introduction to Graph Theory, Network flow and matching, Introduction to Number Theory.

MAT315 Numerical Analysis

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MAT112**

The main objective of this course is to familiarize the students with the fundamental concepts of Numerical computations which will be used as background knowledge for the understanding of specialized courses in the fields of artificial intelligence and computer engineering.

The course will develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integrals numerically. It also sheds light on curve fitting including regression and interpolation models. The course will further develop problem solving skills needed in computer engineering and science.

MAT316 Statistical Modelling

3 Cr. Hrs (*2*LCT+*0*TUT+*3*LAB + *0* OTH) - SWL=*150*- – ECTS =*5*

Prerequisite: Biostatistics **PHS236**

This course addresses the appropriate selection of variables to recreate statistical models, model integrity, the concept of the r2 statistic with application to linear regression and logistic regression models.

MAT495 Special Topic

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Advanced topics related to field.

Department of Public Health Sciences

PHS021 Public health Geography

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite*:* **None**

Definitions and History. Spatial Factors affecting Human health. Classification of geographical distribution of infectious and Chronic Diseases. Spatial Relationship between chronic diseases and professional type. Climate change and future distribution of infectious and chronic Diseases

PHS131 Basic Epidemiology

2 Cr. Hrs (*1*LCT+ *2* TUT+*0*LAB+ *0* OTH) - SWL=*150* – ECTS =*5*

Prerequisite: None

This course is an introduction to the basic principles and methods of epidemiology. This course emphasizes critical thinking, analytic skills, and subsequent application to clinical practice and research. Topics covered will include outcome measures, methods of adjustment, surveillance, quantitative study designs.

PHS132 Medical terminology and Professional Writing and

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB) - SWL = *105* – ECTS =*4*

Prerequisite: LAN021

This course provides the basic tools of analytical reasoning, teaching students how to think effectively. Although this course is philosophical by nature, it is essential to every major discipline, including medicine and the health sciences. The course will introduce a wide range of reasoning skills, such as verbal argument analysis, formal logic, quantitative reasoning, scientific methodology, and creative thinking. This course will also introduce students to writing and other communication tools that scientists employ, which will prepare students for effective communication. This course will cover writing for an academic journal, creating effective graphs, researching scientific databases, scientific posters, as well as communication ethics.

PHS133 Professionalism in Public Health

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB) - SWL = *105* – ECTS = *4*

Prerequisite: None

This course will help students understand the concept of professionalism and how it relates to their own competence, confidence, commitment, and awareness as a professional. The course will introduce key ethical frameworks and concepts relevant to public health research and practice. The course will also use a case-based approach to ethical dilemmas in several domains, including resource allocation and distributive justice, autonomy and paternalism, health promotion and disease prevention, research ethics, clinical care, and emerging issues in public health ethics. The course will cover professionalism in communication, interpersonal relationships, integrity and appropriate professional practices, confidentiality, population or patient safety, appropriate lab safety practices and safety in the field.

PHS134 Health Psychology:

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS =*3*

Prerequisite None

This course introduces the basic concepts of health psychology, including the different medical disorders and diseases and their impacts on psychological health psychological functioning of individuals. This course will also examine physical limitations and adaptations, accessibility issues, psychological treatments, depression and illness, traumatic injuries, as well as neuromuscular diseases, cancer, and chronic pain, and promotion of health behaviors.

PHS135 Communication, Behavioral Change and Sociocultural Dimensions

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisite: None

This course covers Hoefstede's dimensions of culture, theories of behavioral change, diffusion of innovation and communication strategies and approaches for collaborating with communities. The course is meant to equip the students with the knowledge and skills for change management in diverse cultures.

PHS200 Field Training Experience

1Cr Hrs=(***4*** field+***0*** LCT+***0***TUT+***0***LAB)-SWL=***90***– ECTS =***3***

Prerequisite None

Training to prepare students to consider public health as a career to ensure a future where the community benefits from a more diverse and better trained public health workforce. During their internships/fellowships, students work in a variety of public health settings including community organizations, health departments, university-based programs, provide students with opportunity to apply theories, principles, and skills learned in the first two levels of the program, and it should provide the internship supervisor with an opportunity to assess the professional strengths and weaknesses of students.

PHS211 Basics of Nutrition

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150***– ECTS =***5***

Prerequisite: BMS144

An integrated overview of the physiological requirements and functions of protein, Fat , carbohydrates and the major vitamins and minerals that determine health and diseases, with an emphasis on human populations. Topics covered major nutrients - their dietary sources, intake levels, physiological roles, and their requirements, as well as the role of nutrition in health/growth, and the relationship between diet and chronic illnesses.

PHS221 Introduction to Environmental and Occupational Health

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***3*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: CHE143

This course covers the relationship between people and the environment, how the environment affects physical well-being, and ways of influencing the quality of the environment and enhancing health protection. This course also introduces major concepts and issues in occupational health and safety. Students identify a conceptual framework for working with populations of workers and identify work-related hazards are controlled.

PHS231 Research Methods in Public Health

2 Cr. Hrs (***1***LCT+ ***2*** TUT+***0*** Lab) - SWL=***150*** – ECTS =***5***

Prerequisite: None

This course prepares students to design their own empirical research and evaluate other public health research. The course begins with a strong foundation in social science, describing the several theoretical approaches used in public health. The course also explores the details

of public health research design, covering qualitative, comparative, and quantitative research design and analysis methods.

PHS232 Health Informatics

2 Cr. Hrs. = (***1***LCT + ***2*** TUT + ***0*** LAB + ***0*** OTH) – SWL = ***90*** – ECTS =***3***

Prerequisite None

This course introduces public health students to the interdisciplinary field of health informatics - the optimal usage of knowledge, data, and information in the advancement of individual health, health care, public health as well as health-related research. This course also evaluates health informatics from a stakeholder perspective, examining the role of information professionals and the extent to which technology can help meet the health information needs of various users such as healthcare services providers, clinicians, health educators, consumers, patients, and caregivers.

PHS233 Introduction to Communicable Diseases and Surveillance

2 Cr. Hrs. = (***1*** LCT + ***2*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS = ***4***

Prerequisite: BMS171

An introduction to the cycle of communicable disease, methods of transmission and epidemiology, and principles of public health surveillance, its different uses, and legal basis for disease reporting. This course will explore the steps in establishing a surveillance system, as well as the steps to evaluate this system. This course will also highlight and compare surveillance systems from a local, governorate, national and international level.

PHS234 Introduction to Non-Communicable Diseases

3 Cr. Hrs. = (***3***LCT + ***0*** TUT + ***0*** LAB) - SWL = ***150*** – ECTS = ***5***

Prerequisite: BMS135

This course explores global non-communicable diseases (NCD), disease burden and associated risk factors, and the interplay between various NCDs in terms of morbidity and mortality, paying close attention to NCDs that significantly impact the global burden of disease.

PHS235 Health Promotion and Education

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS = ***4***

Prerequisite: PHS135, PHS134

An exploration of the various topics that affect the profession of health education and health promotion. This course will introduce the historical origins of health education and public health, examine learning theories, and will critically examine emerging issues and trends in the field and professional responsibilities of public health educators. It will also cover behavioral change, communication, and disease prevention

PHS236 Biostatistics

3 Cr. Hrs. (***2***LCT+ ***1*** TUT+***2*** LAB+ ***0*** OTH) - SWL=***150***– ECTS = ***5***

Prerequisite: None

This course provides public health students with the biostatistical methods and principles necessary in understanding and interpreting public health data, with the aims of policy evaluation and formation. Topics covered in this course include descriptive and analytic statistics, graphical, tabular, and mathematical data presentation, sampling, statistical comparison of groups, correlation, and regression, parametric and non-parametric tests. Classroom instruction will include lectures, group discussions, critical reading of published research, and analysis of data using a chosen statistical software. The statistical packages

used will include SPSS, Satsdirect, SAS, and STATA.

PHS241 Healthcare Systems and Primary Healthcare

2 Cr. Hrs (***2***LCT + ***0*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisite: None

This course addresses the roles of patients, physicians, hospitals, insurers, and pharmaceutical companies along with the interaction between the government and these different groups. The course aims to provide skills for critical and analytical thought about the Egyptian health care system and the people in it. This course examines the structure of health care systems in different countries as well, focusing on financing, reimbursement, delivery systems and adoption of new technologies. A special focus is given to the relative roles of private sector and public sector insurance and providers, and the effect of system design on cost, quality, efficiency, and equity of medical services. Current national health care policy initiatives will steer topics covered in the course.

PHS251 Introduction to Healthcare Management

2 Cr. Hrs (***2***LCT + ***1*** TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: None

The course provides an overview of how health care institutions are organized and governed, the role of management, clinical and support staff in these organizations. It addresses the management systems designed for their efficient and effective operation. Using case studies, students learn concepts and theories in health care management and integrate health care management theory with real world situations.

PHS261 Principles of Genomics

2 Cr. Hrs. = (***1*** LCT + ***0***TUT + ***2***LAB + ***0*** OTH) - SWL = ***135*** – ECTS =***5***

Prerequisites: None

This course introduces genetics and new genomic technology, and highlights how they impact the community, individual health, public health, and health service delivery. The course will introduce genomic testing and screening methods, examine the utility of genomics throughout the life stages, consider the interplay between genes and environment; debate the various ethical and social issues associated with genomic technology, and finally investigate current and future service delivery issues. This course also assesses genomic technology from clinical, financial and policy perspectives.

PHS311 Global demographics and Burden of Disease

3Cr. Hrs (***2***LCT+ ***2*** TUT+***0***LAB+ ***0*** OTH) - SWL=***150***– ECTS =***5***

Prerequisite: PHS131, PHS236

This course explores how human populations grow and how they change by birth, death, and migration. It examines how and why birth and death rates change, and how governments and other groups attempt to consider the effects of birth rates, death rates, and migration on public health, the economy, the environment, and other aspects of human well-being. The course then introduces students to the concepts, technical components, and quantitative methods for burden of disease measurement. This course focuses on constructing aggregate measures such as years of life lost (YLL), years lived with disability (YLD), and disability-adjusted life years (DALYs). Furthermore, this course will discuss a range of measurement techniques that combine information on mortality and nonfatal health outcomes for a host of different diseases. This course will provide students with an understanding of the methodological and empirical

basis for quantifying burden of disease estimates for national and global health priorities. Students will learn how to use sparse data covering mortality, morbidity, causes of death, individual health status, and condition-specific epidemiology to determine levels of health within different populations, particularly in developing countries.

PHS312 Global Climate Change

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisite: PHS221

This course aims to address the complexity of climate change as a global environmental challenge. This course will combine the evidence-based science and the fundamental physical processes underlying climate change, its potential impacts such as sea level change and vegetation/precipitation changes, analysis, as well as abatement/mitigation/adaptation technologies, communication tools and policy solutions.

PHS313 International Studies in Public Health

3Cr. Hrs (***2***LCT+ ***2*** TUT+***0***LAB+ ***0*** OTH) - SWL=***135***– ECTS =***5***

Prerequisite: None

This course introduces students to theories of globalization and their impact on healthcare, particularly in low- and middle-income countries (LMIC), laws and ethics, and international health security, explore the overall political makeup of the international system, gain insight into development issues and the challenges faced by developing countries. It also examines the workings of economic systems from the perspective of the incentives facing the firm and consumer and introduces the economics of information and organization which is used to evaluate resource allocation under the specific institutional environment of different economic systems. The course also samples aspects of international and human rights laws that are pertaining to health.

PHS314 Health Inequities

2Cr. Hrs (***1***LCT+ ***2*** TUT+***0***LAB+ ***0*** OTH) - SWL=***135***– ECTS =***5***

Prerequisite: PHS329

This course teaches the students to address systemic differences in health and wellness that are, actionable, unfair, or unjust, to explore policies and strategies for changing the culture of organizations, engaging community members, and negotiating with political pressures strategically, to examine what frames influence public health work. Discuss how values, assumptions, and interests affect the capacity for addressing health inequities, Explore the transformation of public health during the last 150 years, including the forces that advanced or limited the field in various countries and settings. The course examines the importance of class structure, racism, and gender inequity in the development of health inequities and explores the principles of social justice and ways to influence the institutions and agencies that generate health inequity.

PHS315 Communicable Disease Prevention and Control

3 Cr. Hrs (***2*** LCT+***2*** TUT+***0***LAB+ ***0*** OTH) - **SWL=150 – ECTS =*5***

Prerequisite: **PHS131 ,PHS233**

BMS171 Foundations of Infections and Infestations

This course discusses the major methods for transmission of communicable disease, their risk factors and disease characteristics, the disease geographical distribution, methods for controlling and preventing transmission.

PHS316 Global Politics of Public Health

3Cr. Hrs (**2**LCT+ **2** TUT+**0**LAB+ **0** OTH) - SWL=**135**– ECTS =**5**

Prerequisite: PHS135

This course will critically examine how international powers and policy instruments of international and supranational institutions, new global actors, and emerging economies are transforming the process and content of health policy. It will also highlight challenges facing the World Health Organization in fulfilling its mandate, and critically assess recent attempts at institutional and policy reform.

PHS317 Health and Livability

2 Cr. Hrs. = (**2** LCT + **0** TUT + **0** LAB) - SWL = **135** – ECTS =**5**

Prerequisite: None

This course introduces health and livability, principles of public health, how to measure public health referring to principles of epidemiology, social determinants, and planning for health. Further, it will refer to planning and measuring livable city.

PHS318 Mortality Surveillance Methods & Strategies

3Cr. Hrs. (**2**LCT+ **2**TUT+**0**LAB+ 0 OTH) - SWL=**135**– ECTS =**5**

Prerequisite: None

Reliable and timely information on cause-specific mortality is a critical part of identifying emerging health problems and a fundamental component of evidence-based health policy development, implementation, and evaluation. Efforts to measure population-level impact of global epidemics, including HIV/AIDS, and develop effective responses are complicated by a lack of dependable mortality data in countries with the highest burden of disease.

This course will provide participants with a basic understanding of the importance and usefulness of mortality data and introduce a range of approaches to collecting such data. The advantages and limitations of the various methods will also be discussed.

PHS 319 Motivational Interviewing in Public Health Settings

2 Cr. Hrs. = (**2** LCT + **0** TUT + **0** LAB) - SWL = **90** – ECTS =**3**

Prerequisite: None

This course is designed to introduce students to Motivational Interviewing, its concepts, and to the subsequent skills required for helping people to change.

PHS320 Cellular and molecular biology I (from molecules to tissues)

Prerequisites: BMS144, PHS261

This course introduces the proteome and methods of investigating and analyzing it. The course covers an introduction to mass spectrometry equipment and how it functions, the type of data the equipment delivers after analyzing and the principles of interpreting its output and using it for further statistical analysis.

PHS321 Air and Water Pollution:

2 Cr. Hrs. = (**1**LCT + **0** TUT + **3** LAB + **0** OTH) - SWL = **105**– ECTS =**4**

Prerequisite: CHE143, PHS221

Highlighting all the major, practical aspects of air pollution control, Students will learn about the environmental effects of air pollution, air pollution meteorology, measurement and control of emissions, pollution prevention, laws and regulations, and compliance enforcement, types, sources and nature of water pollution, water quality management practices, water supply and treatment water quality criteria and standards. Highlighting all the major, practical aspects of air pollution

control, Students will learn about the environmental effects of air pollution, air pollution meteorology, measurement and control of emissions, pollution prevention, laws and regulations, and compliance enforcement, types, sources and nature of water pollution, water quality management practices, water supply and treatment water quality criteria and standards.

PHS322 Food Safety, Food Security and Surveillance of Foodborne Disease

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisite: PHS211

An investigation into food safety and quality issues, including microbiological and viral threats from food, and the mitigation of food safety 8threats in food handling facilities. Also covered are allergen control, modern plant sanitation techniques and pest management, and laws related to food safety.

PHS323 Management of Mass Gatherings

2Cr. Hrs. (***1***LCT+ ***2*** TUT+***0***LAB+ 0 OTH) - SWL=***135***– ECTS =***5***

Prerequisite: PHS315

This course covers the public health guidelines for mass gatherings and the national preparedness plans for such events in Egypt and other countries.

PHS324 Occupational Safety

3 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***2*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: PHS221

Exploring occupational safety and ergonomics, students will learn safe work practices in a variety of settings, including offices, industry, and construction. Hazard identification, prevention and communication are also covered in both home and workplace. Associated with occupational safety and health in these locations as well as in the home. This course will also cover biomechanical principles behind physical activity.

PHS325 Health Geography

3 Cr. Hrs. (***2*** LCT + ***2*** TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: PHS236

An advanced course exploring the natural (climate and environmental pollution) and social environments and determinants of health (housing, transport, availability and accessibility to healthcare, legislation). This course also investigates and follows the media to highlight changes in public perceptions and attitudes towards health and health geography. This course will also cover both urban and rural health issues.

PHS326 Air Quality Management

3 Cr. Hrs. (***2*** LCT + ***0*** TUT + ***2*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: None

Highlighting all the major, practical aspects of air pollution control, this is a multidisciplinary course merging science, technology, and regulatory aspects associated with air pollution. Students will learn about the environmental effects of air pollution, air pollution meteorology, air quality management, ambient air quality monitoring, measurement and control of emissions, pollution prevention, laws and regulations, emission inventories, and compliance and enforcement.

PHS327 Microbes, Man and the Environment

2 Cr. Hrs. = (***1*** LCT + ***2*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisite: PHS221, PHS233

This course delivers the basic principles of microbiology, virology, and mycology, explores how microbes play a critical role in the global ecosystem and how they evolved from more primitive life forms to colonise new environmental niches. Topics covered include diversity of

energy-generating systems of microbes, microbial structure, replication and motility, carbon and Nitrogen cycling in the ecosystem, microbial associations with plant roots. Legumes, rhizobia and nitrogen fixation, microbial associations with animals and insects: ruminants and hind gut fermenters. Cellulose digestion, methanogens and chytrids, termites and leaf cutter ants. Human-microbe interactions, bacterial pathogenicity, bacterial exotoxins and endotoxins, viral diseases of man, microbial pathogens of plants and insects, colonisation and invasion strategies, antmicrobial agents; targets and modes of action and microbial biotechnology covering microbes and food, food spoilage and toxins, the use of microbes in food and beverage production, exploitation of natural microbial communities in the treatment of sewage, exploitation of bacteria for plant transformation for the production of genetically modified crops, and the use of bacterial toxins and resistance genes for novel pest and weed control.

PHS328 Water Quality and Disease Control

3 Cr. Hrs. (***2*** LCT + ***0*** TUT + ***2*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: None

This course covers the principles of science and engineering used in the evaluation and control of water quality. The course covers current legislation, types, sources and nature of water pollution, water quality management practices, water supply and treatment, hydrologic concepts, effects of waste discharge on water, lake management, and water quality criteria and standards.

PHS329 Health Determinants

2Cr. Hrs. (***1***LCT+ ***2*** TUT+***0***LAB+ ***0*** OTH) - SWL=***135***– ECTS =***5***

Prerequisite: PHS135

This course introduces the students to how social factors, both contextual (e.g., poverty, housing, education) and interpersonal (e.g., racism, social support, stigma) are important contributors to health outcomes, how these factors influence health, both individually and in combination, and how this information can lead to the development and implementation of more effective health promotion programs and policies.

PHS331 Advanced Epidemiologic Methods

3 Cr. Hrs. (***1*** LCT+ ***2*** TUT+***3*** LAB+ ***0*** OTH) - SWL=***150*** – ECTS =***5***

Prerequisite: PHS131, PHS236, PHS231

This course aims to teach the students to critically read and interpret epidemiologic studies that apply advanced methods for analysis and interpretation, recognize how advanced methods relate to and build upon more traditional epidemiologic methods and demonstrate an ability to identify appropriate situations for the application of various advanced epidemiologic methods. The course discusses the problems caused by missing data, describes mechanisms of how missing data arise, and analytical methods used to analyse datasets with missing data. The course introduces the concept of casual inference, teaches students to use directed acyclic diagrams to represent possible causal pathways, and describes analytical approaches exploring causality in epidemiological data. Students learn to distinguish effect modification from confounding, understand the concept of effect modification on additive and multiplicative scales, describe the importance of effect modification in generalizing results from studies, and demonstrate methods of presenting effect modification. The course also explores how random measurement error affects the estimates of associations between exposure and outcome variables, shows how this relates to regression dilution bias, and recall methods used to deal with random measurement error.

PHS332 Clinical Epidemiology

3Cr. Hrs. (***2***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***135***

Prerequisite: PHS131

This course aims to deliver an understanding of the use of the term clinical epidemiology and how to frame clinical questions, develop an ability to evaluate results of clinical trials, understand the use of diagnostic tests and develop an understanding of the use of clinical decision analysis. The course covers assessing the validity of studies, communicating the benefits and harms of treatments, diagnostic studies, sensitivity, specificity and predictive values, ROC curves, likelihood ratios, pre and posttest probabilities.

PHS333 Prevention and Control: Vaccines and Immunization

2 Cr. Hrs. = (***1*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisites: PHS233

This course addresses vaccine development and testing, historical perspectives, current global immunization schedules. The students learn to utilize epidemiologic methods and study designs to assess both individual and population-level vaccine efficacy and to develop and implement strategies to address the challenges of achieving and maintaining high vaccine coverage in diverse communities .

PHS334 Epidemiology of Non-Communicable Diseases, Mental Health and Ageing

2 Cr. Hrs. (***1*** LCT+***2*** TUT+***0*** LAB+ ***0*** OTH) - SWL=***135*** – ECTS =***5***

Prerequisite: PHS131

This course will focus on the considerable and increasing burden of disease due to chronic diseases, mental health, substance use (alcohol, tobacco, other drugs), risk factors (obesity, lack of physical activity), and injuries within the developing world. It will present methods for measuring the burden of non-communicable disease, review approaches to program and service development to modify risk factors, present lessons learned from successful developing country programs, and discuss implications for health services development and international development policies.

PHS336 Questionnaire Design and Validation

2 Cr. Hrs. (***1***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***135*** – ECTS =***5***

Prerequisite: None

This course introduces students to theories underpinning questionnaire design and methods of developing constructs and domains of questions. The course also teaches methods of cross-cultural adaptation and translation of questionnaires, and how to evaluate, validity and reliability of a questionnaire tool.

PHS337 Cancer Epidemiology

3 Cr. Hrs. (2LCT+2TUT+0LAB + 0 OTH) - SWL=135 – ECTS =5

Prerequisite: PHS131

This course aims to provide knowledge in the epidemiology of cancer covering cancer incidence and mortality rates, survival statistics and burden of disease, cancer screening, familial and hereditary cancers, environmental and biological carcinogenic hazards, and the process of carcinogenesis. The course also covers survival analysis methods and cancer registry training.

PHS338 Molecular and Genetic Epidemiology

3 Cr. Hrs. (***2***LCT+***0***TUT+***3***LAB + ***0*** OTH) - SWL=***150*** – ECTS =***5***

Prerequisite: PHS131, PHS261

This course provides an overview of the growth of molecular and genetic data sources since the Human Genome Project and the public Health implications of these advances, the role of high throughput equipment in providing genomic data suitable for public health research and practice, the move to the 4P personalized healthcare model and the integration of genomic data into public health research and practice. The course also covers the basic principles of genetic epidemiology; Hardy-Weinberg equilibrium, haplotypes, genetic mapping measures, linkage disequilibrium, data quality control, study design, population stratification. The course also includes an overview of gene association studies, linkage and segregation studies, and genome wide association study designs.

PHS341 Cultural Competency in Healthcare Administration

3 Cr. Hrs. (***2*** LCT+ ***2*** TUT+ ***0***LAB) - SWL=***150***– ECTS =***5***

Prerequisite:PHS134

This course will discuss the concept of culture, how it changes and influences everyday life, health disparities, and what best practices for enhancing cultural competencies in healthcare organizations and systems. This course will discuss the concept of culture and how systems should incorporate strategies to mitigate those aspects of cultural alienation that result in adverse health outcomes. The course will examine organizational structures and processes that should incorporate cultural competence, and students will explore how all professional roles in health care settings (providers and administrators) should address service adjustments and measure effectiveness of care and quality of health outcomes across multicultural populations.

PHS342 Health Care Ethics & Law

3 Cr. Hrs. (***2***LCT+ ***2*** TUT+ ***0***LAB) - SWL=***150***– ECTS =***5***

Prerequisite: PHS133

This class is designed to introduce the legal and ethical environment of Management of Health Services Institutions. The course will examine ethical decision-making by leaders in healthcare administration. A student will learn to draw on ethical principles and virtues, theories, caring and empathy to make complex ethical decisions. The course will address many of the ethical issues within healthcare organizations, including patient concerns, balancing of the fiscal and ethical responsibilities of healthcare organizations. It will then cover legal issues facing health service administrators including the government regulation of healthcare, informed consent, hospital and provider individual and corporate negligence, Egyptian contract law, the legal basis for hospital governance, and the principals and basis for health care malpractice insurance.

PHS343 Health Economics

4 Cr. Hrs. (***3***LCT+ ***2*** TUT+ ***0***LAB) - SWL=***165***– ECTS =***6***

Prerequisite: None

The goal of the course is to expose students to health economics in order to develop an understanding of economic principles as applied to health and health care. Emphasis will focus on developing countries in general and Egypt in particular. Students should apply economic concepts and techniques to analyze issues in health and health care; and understand the principles and techniques of economic evaluation of health interventions using the basic principles of epidemiology.

PHS345 Health Care Quality Management

3 Cr. Hrs. (***2***LCT+ ***2*** TUT+ ***0***LAB) - SWL=***150***– ECTS =***5***

Pre-requisites: None

The purpose of this course is to familiarize the student with the concept of quality and the process of Quality Improvement across the HealthCare continuum. This course focuses on the history and evolution of quality, its terms, principles, theories, and practices. The student is introduced to a diverse collection of methods of improving quality, including but not limited to continuous Quality Improvement and Total Quality Management, and to the guidelines for implementing quality management and the continuous quality improvement processes. Students will be familiarized with Six Sigma and other tools that are an integral component of Process Improvement and Customer Satisfaction. Learners explore the role of leadership in the success of quality and performance improvement initiatives. Quality management (including patient safety, risk assessment and prevention, peer review, and patient experience and satisfaction) and performance improvement and management concepts, systems, practices, and technologies are examined.

PHS346 Introduction to Laboratory Science and Safety

2 Cr. Hrs. = (***1*** LCT + ***0***TUT + ***3***LAB + ***0*** OTH) - SWL = ***135*** – ECTS =***5***

Prerequisites: None

The course introduces lab safety strategies, infection control, principles of waste disposal in the lab, techniques of handling lab equipment, logbook procedures and other essential lab procedures.

PHS347 Health Risk Assessment and Management

3Cr. Hrs. (***2***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***150***

Prerequisite: PHS131, PHS221

This course addresses the basic concepts and principles of health risk assessment, hazard identification and characterization. the different types of data from in vivo/animal, epidemiological and in vitro studies as well as exposure data that are used in risk assessment, how the relevance and reliability of the data is assessed, and how different kind of evidence is integrated (for example from animal and epidemiological studies), the principles on how to derive health-based guidance values such as Acceptable Daily Intake (ADI) and to derive Margins of Safety values based on the data are exercised and how to derive health based guidance values such as Acceptable Daily Intake (ADI) based on the data. The course reflects on the role of health risk assessment in regulatory decision making.

PHS351 Human Nutrition & Metabolism

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: PHS 261, BMS 101

The course discusses in depth the nutritional, biochemical, and physiological aspects of carbohydrates, lipids, proteins, vitamins, and minerals. It focuses on the absorption mechanisms and transportation of the different nutrients.

PHS352 Assessment of Nutrition Status

3 Cr. Hrs. = (***2*** LCT + ***0***TUT + ***3*** LAB) - SWL = ***150***

Prerequisite: PHS 261

Methods and tools used in screening and assessment of nutritional status of individuals and population groups are studied. Assessment methodology includes dietary surveys, dietary intake analysis,

anthropometric measures, biochemical measures, and clinical evaluations. Standards of evaluation and validity of procedures used in national surveys and other pertinent studies will be discussed.

PHS353 Nutrition along Lifecycle

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: PHS 351

The course focuses on the nature, composition, and specific needs of individuals throughout their life span. It covers the physiological changes and requirements during infancy, childhood and adolescence, adulthood, and the elderly with special emphasis on the needs during periods of physiological stress such as pregnancy and lactation.

PHS354 Theories & Techniques of Nutrition Education

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: PHS 351, PHS 353

The course discusses the various methods and techniques used in nutrition education of the individual and the community. It focuses on the selection of the appropriate method of communication according to the target group of the education program. The student will be trained in the development of educational material that suits the conditions prevailing in the region.

PHS355 Community and Public Health Nutrition

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: PHS 135, PHS 352

Corequisite: PHS 353

This course will introduce Community and Public Health Nutrition and the role of the Community and Public Health Nutrition professionals. It offers a comprehensive perspective on nutritional epidemiology, assessment of the food supply and environment, collection, analysis, and interpretation of dietary intake data for communities and populations, and program planning, implementation, and evaluation. The distinction between population-based and individual-based approaches to prevention and alleviation of diet-related conditions, and the barriers to improving the nutrition status and health of diverse population groups will be emphasized. Other topics covered include food and nutrition policies and legislation, and food assistance programs and Hunger in the context of SDGs

PHS356 Clinical Nutrition 1

3 Cr. Hrs. = (***2*** LCT + ***0***TUT + ***3***LAB) - SWL = ***165***– ECTS =***6***

Prerequisite: BMS135

The course includes an introduction to nutrition in health care and hospital nutrition. Students will understand principles and application of medical nutrition therapy as related to specific disease states. Topics include the nutrition care process, nutrition screening and assessment in hospital settings, and an introduction of therapeutic diets.

PHS357 Obesity Control and Prevention

3 Cr. Hrs. (***2*** LCT+ ***2*** TUT+ ***0***LAB) - SWL=***150***– ECTS =***5***

Prerequisite: None

Obesity is one of the major global public health problems. This course will focus on definition and classification of obesity, its global burden and consequences as well as exploring the basic principles of, and latest trends in, weight management. This course includes coverage of assessment techniques, behavioral and non-behavioral treatment approaches, and prevention strategies.

PHS 358 Food Laws and Regulations

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***90*** – ECTS =***3***

Prerequisite: None

The course explores the history, importance, development and enforcement of local, national, and international food laws and regulations that affect the food processing industry and food consumers and how they contribute to a safe, nutritious, and wholesome food supply. In addition, the course will give students a comprehensive awareness of the different types of food standard, especially those in connection with food quality, safety, and labelling, marketing, grading, food additives as well as toxic and harmful substances in foods and international trade.

PHS 359 Food Marketing and Consumer Behavior

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***90***

Prerequisite: None

Psychological and environmental (physical and social surroundings) factors influence our food choices, often beyond physiological signals such as hunger and satiety. In this course students will learn about basic marketing and consumer psychology principles, which can help promote new food products and create healthier food environments in the long

PHS361 Cellular and Molecular Biology I

3 Cr. Hrs. = (***1*** LCT + ***2***TUT + ***3***LAB + ***0*** OTH) - SWL = ***150*** – ECTS =***5***

Prerequisites: BMS144

This course aims to build knowledge of the cell and the important biological molecules from a bottom-up approach starting with molecular components to cellular organelles. Topics covered include: the chemical basis of life, DNA and RNA structure, peptides, enzymes, hormones, the cell membrane, ribosomes, mitochondria, cell replication and signaling, cell division and the cell cycle, techniques in molecular biology.

PHS362 Human immunology and immune markers

2 Cr. Hrs. = (***1*** LCT + ***0***TUT + ***3***LAB + ***0*** OTH) - SWL = ***135*** – ECTS =***5***

Prerequisites: BMS144

This course aims to introduce students to key aspects of the human immune system and human immunology. Topics covered include the development of the human immune system and the nature of human immune responses, key concepts of Autoimmunity and Autoimmune Diseases, with focus on Systemic Lupus Erythematosus (SLE), key roles of the immune system in cancer development and current Cancer Immunotherapy.

PHS363 Legal, ethical & Social Issues in Applied Genetic

2 Cr. Hrs. = (***1*** LCT + ***2***TUT + ***0***LAB + ***0*** OTH) - SWL = ***105*** – ECTS =***4***

Prerequisites: None

The course considers issues of human confidentiality, autonomy, disclosure, informed consent, and natural justice within an ethical framework. The course explores the impact of genomic technologies on individual lives and those of demographic and ethnic groups. There will also be an opportunity to discuss the social implications of the availability of genetic testing and screening, especially in the context of reproductive technologies taking into account demographic and ethnic differences. The course also discusses the pertinent issues related to the development of new genomic technologies.

PHS364 Structure and Function of the Human Genome

3 Cr. Hrs. = (1 LCT + 2TUT + 3LAB + 0 OTH) - SWL = 165 – ECTS =6

Prerequisites: PHS261

This course aims to introduce the students to the structural units of the human genome and their normal variations, as well as the pathogenic variations. The course also covers chromosomal structure and cell division stages, inherited abnormalities, gene functions and the concept of sequence, RNA role as messenger and cell signaling

PHS365 Pathophysiology II from Tissues to Organ Systems and healthy Humans

2 Cr. Hrs. = (***1*** LCT + ***2*** TUT + ***0*** LAB) - SWL = ***135*** - ECTS = ***5***

Prerequisite: BMS135, PHS361

This course builds on what is taught in PHS Cellular and Molecular Biology I from molecules to tissues by continuing further in a bottom-up approach from tissue structure and function to organs and organ systems, and finally the human being in health and in disease.

PHS366 Library Preparation for Sequence Analysis

2 Cr. Hrs. (***1***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***135***– ECTS =***5***

Prerequisite: PHS364

In this course, students learn how to assemble a library on the software used for sequencing data for various equipment.

The course will provide a focus on applications relevant to Public Health.

PHS367 Introduction to proteomics & mass spectrometry

2 Cr. Hrs. (***1***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***135***– ECTS =***5***

Prerequisite: PHS322

This course will help students develop knowledge of proteomics as well as the current trends within the protein technology and proteomics field.

PHS368 Genome Sequencing Technology

Prerequisites: PHS364

The course explores the technology of gene sequencing and its progress over time, how the currently available equipment operates, the microflow of the samples inside the machine, sample preparation, library building, setting up the sequencing project, interpreting the sequencing data, using the manufacturer's software and third-party software, analyzing sequencing data. The course will provide a focus on applications relevant to Public Health.

PHS369 Genome Wide Association Studies

3Cr. Hrs. (***1***LCT+ ***2*** TUT+***3***LAB+ ***0*** OTH) - SWL=***165***– ECTS =***6***

Prerequisite: PHS364

This course will introduce students to the basic principles of analyzing genotyping individuals at common variants across the genome using genome wide SNP be next-gen sequencing approach

PHS391 Motivational Interviewing in Public Health Settings

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***90*** – ECTS =***3***

Prerequisite: None

There has been increased interest in motivational interviewing (MI) to address chronic diseases and other public health conditions as smoking, diet, or diabetes management. The course will provide students with an in-depth overview of MI and provide opportunities to practice core technique

PHS400 Capstone Project

4 Cr. Hrs. (0LCT+ 0 TUT+12LAB+ 0 OTH) - SWL=150 – ECTS =5

Prerequisite: Senior Standing

Students use their previous learning and acquire skills to develop, implement and analyses a public health project in their area under the guidance of a faculty staff member. The students may work singly or in groups and may collaborate with other students of the Faculty of Public Health from different specialties.

PHS411 Maternal, Neonatal, Child and Adolescent Health

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisites: None

This course Provides a public health perspective of maternal and child health. Includes information on indicators of maternal, infant, and child health; risk factors for pregnancy complications, infant and child morbidity and mortality; and impact of maternal and child health on life course disease risk. The course is designed so that students understand

the clinical and social causes of high maternal and newborn mortality and morbidity. Exposes students to the clinical, program and policy interventions that address these issues, and evaluates the strength of the evidence supporting these interventions.

PHS412 Sexual and Reproductive Health

3 Cr. Hrs. = (***2*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisites: None

The course addresses the basic biological mechanisms that underlie male and female reproduction and that pertain to reproductive health issues, such as contraception, infertility, sexually transmitted diseases, and reproductive aging. The course addresses the social and economic aspects of human fertility, will explore fertility transitions in India, China, the USA, and Sub-Saharan Africa, will examine major distal and intermediate determinants of fertility and will consider policies affecting fertility around the world.

PHS413 NCDs, Mental and Geriatric Health

2 Cr. Hrs. = (***1*** LCT + ***2***TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisites: None

Students will examine a variety of perspectives and contextual factors used to explore issues and concepts of mental health. Distribution patterns, risk factors, organization of health systems, and societal efforts toward prevention and treatment will also be reviewed. A focus will be placed on understanding the social determinants of mental health and exploring issues from a population and public health perspective. The prevalence and distribution of mental disorders and substance use disorders, gain an understanding of prominent risk factors for mental disorder and harmful substance use and preventive strategies to decrease risk throughout the life course, explore common mental health issues and challenges that arise during the life course and public health approaches to promote mental health and develop an understanding of the structure and organization of public services, policies and supports (including healthcare services, social services, and legislation) that exist to address mental illness and substance use disorder.

PHS414 Gender-based Violence Research, Practice and Policy

2Cr. Hrs. (**1**LCT+ **2** TUT+**0**LAB+ **0** OTH) - SWL=**135**– ECTS =**5**

Prerequisite: PHS135

This course explores gender-based violence (GBV), including intimate partner violence, sexual violence, and sex trafficking. Topics include the following as they relate to GBV: epidemiology, theoretical frameworks, structural risks and gender equity, policy, prevention and intervention, perpetrators, populations with unique needs, and health consequences spanning sexual and reproductive health, STI, and HIV. Prepares students to undertake meaningful scholarly, community-based, programmatic or policy work in the field. Emphasizes active learning and facilitates application of knowledge and skills gained to real world issues.

PHS415 Population Structure

2Cr. Hrs. (**1**LCT+ **0** TUT+**3**LAB+ **0** OTH) - SWL=**135**– ECTS =**5**

Prerequisite: None

This course aims to examine the population pyramids of various countries, population subgroups, the factors influencing the population structure and the shape of the pyramid, and how this reflects on a nation's health and welfare.

PHS416 Mass Communication in Public Health

2 Cr. Hrs. = (**2** LCT + **0** TUT + **0** LAB) - SWL = **90** – ECTS =**3**

Prerequisite: None

The purpose of this course is to provide students with an understanding of how the media can be used to promote healthy public policy. The primary focus of the course is on "media advocacy." Students will learn how to frame issues from a public health perspective.

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PHS417 survival analysis

2 Cr. Hrs. (**1**LCT+ **0** TUT+**3**LAB) - SWL=**135**– ECTS =**5**

Prerequisite: PHS236

This course will introduce fundamental concepts and techniques of survival analysis including censoring, hazard and survival functions, Kaplen-Meier curves, and log rank tests. Parametric inferences are introduced using the exponential and Weibull distributions.

PHS418 Community Social and Behavioral Interventions

3Cr. Hrs. (**2**LCT+ **0** TUT+**3**LAB+ 0 OTH) - SWL=**135**– ECTS =**5**

Prerequisite: None

The course exposes students to strategies for collaborating with communities, identifying community needs, community development and participatory approaches, action research and developing frameworks for improving uptake of health services and preventive interventions.

PHS419 Reproductive and perinatal epidemiology

3Cr. Hrs. (**2**LCT+ **2**TUT+**0**LAB+ **0** OTH - SWL=**135**– ECTS =**5**

Prerequisite: None

This course is intended to examine methodological approaches and challenges in reproductive or perinatal epidemiology. Topics will cover design, measurement, and analysis in studies of fecundity and fertility, pregnancy and maternal health, and birth outcomes.

PHS421 Environmental Policy, laws and Management

2 Cr. Hrs. (**2** LCT + **2** TUT + **0** LAB) - SWL = **150** – ECTS =**5**

Prerequisite: None

This course revisits and evaluates the key global environmental challenges of previous courses and covers a wide range of policies and environmental management frameworks. The course covers technical, statutory, social, and political policies.

PHS422 Organizational Behavior and change

3 Cr. Hrs. = (**2** LCT + **2** TUT + **0** LAB) - SWL = **150** – ECTS =**5**

Prerequisite: PHS324

In this course, students will examine the behavior of individuals and groups as part of the social and technical system within workplace settings. The course will cover individual and group behavior, communication, conflict and various management styles, motivational techniques, and coordination in the work environment. Students will learn how to apply these concepts to the development of an organization's human resources.

PHS423 Microbiological and Chemical sampling and analysis

3 Cr. Hrs. (**2** LCT + **0** TUT + **2** LAB) - SWL = **150** – ECTS =**5**

Prerequisite: None

This course will explore instrumental microbiological analysis techniques on real samples, including issues such as lab storing techniques. Also examined are instrumental chemical analysis techniques on real samples and sampling of different types of test materials (water, sediment, soil, and air). Relevant ISO / standard routines for sampling and analysis will also be reviewed. Sample storage, sample preparation and quality assurance will also be covered.

PHS424 Capstone Project 1

3 Cr. Hrs. = (**0** LCT + **0** TUT + **0** LAB) - SWL = **90** – ECTS =**3**

Prerequisite: SENIOR STANDING

students will use their field experience to write an integrative learning final paper, a thesis paper, under the guidance of a coordinator/advisor. Completion of this course, along with completion of the necessary credits, will result in the student obtaining their BPH.

PHS425 Industrial Psychology:

2 Cr. Hrs. = (**2**LCT + **0** TUT + **0** LAB + **0** OTH) - SWL = **135** – ECTS =**5**

Prerequisite: None

This course will explore applications of psychology in workplace settings. The focus of this course will be on industrial and organizational psychology, such as job analysis, description, and evaluation; employee selection; performance evaluation; motivation; job satisfaction; leadership; and group and team development through reading, writing, discussion, exercises, and research.

PHS426 Ecosystems Management

3 Cr. Hrs. = (**2** LCT + **0** TUT + **2** LAB) - SWL = **180** – ECTS =**7**

Prerequisite: None

This course is a critical review of the scientific foundations, measures, and goals of ecosystem management for conservation. This course will also incorporate human dimensions as this has a strong social component. Also examined is the efficacy of conservation management within a socioeconomic framework, including stakeholder and roles of ecologists in the process. Students will do this through the investigation of an existing ecosystem management example (fieldwork).

PHS427 Environmental Risk Assessment

3 Cr. Hrs. (**2** LCT + **0** TUT + **2** LAB) - SWL = **150** – ECTS =**5**

Co-req: PHS423

This course will explore the definition of environmental risk and its major elements as well as management. This course will address methods of managing complex environmental risks with the aim of promoting sustainability.

PHS428 Capstone Project 2

3 Cr. Hrs. = (**0**LCT + **0** TUT + **0** LAB) - SWL = **90** – ECTS =**3**

Prerequisite SENIOR STANDING

students will use their field experience to write an integrative learning final paper, a thesis paper, under the guidance of a coordinator/advisor. Completion of this course, along with completion of the necessary credits, will result in the student obtaining their BPH.

PHS431 Humanitarian Assistance

2Cr. Hrs. (**2**LCT+ **1** TUT+**0**LAB+ **0** OTH) - SWL=**135**– ECTS =**5**

Prerequisite: Human Rights (University Prerequisites)

This course aims to provide knowledge and competence in humanitarian action, disaster prevention, preparedness, and response; and thereby enhance human resource capacity for managing the humanitarian emergencies arising from natural disasters and complex emergencies worldwide. It addresses the laws governing humanitarian action, historical and contemporary perspectives, roles, and agendas of the major stake holders in political, social, and economic context. It further addresses the role of the military in humanitarian interventions, repatriation, and reintegration; tracing post-conflict rehabilitation and demobilization; Managing the transition to sustainable development, economic stabilization, and sustainable livelihoods; and exit strategies in humanitarian assistance programs.

PHS433 Clinical Trials Design and Analysis

3 Cr. Hrs. (**1**LCT+ **2** TUT+**3**LAB+ **0** OTH) - SWL=**150** – ECTS =**5**

Prerequisite: PHS231, PHS 236

The course aims to teach the principles of clinical trial design, covering randomization, blinding, two arm designs, cross-over designs, multiple arm designs, innovative clinical trial designs as hybrid designs and adaptive designs. The course also addresses Phases of clinical trial, and the journey of drug development and approval, International Clearing House Good Clinical Practice (ICH GCP) guidelines and management of clinical trial implementation, EU Directive for clinical trials, and site monitoring. Methods of statistical analysis of clinical trial data will be taught.

PHS434 Systematic Reviews and Meta-analysis

3 Cr. Hrs. (**1**LCT+ **2** TUT+**3**LAB+ **0** OTH) - SWL=**150** – ECTS =**5**

Prerequisite: PHS231, PHS236, MAT316

This course aims to teach the students how to conduct a meta-analysis starting from developing focused literature search strategy to extracting the studies and reviewing them for inclusion/exclusion criteria, to data extraction and conducting meta-analysis using various software platforms. The students will understand and interpret fixed-effects, random-effects, and meta-regression methods and results; and recognize heterogeneity and approaches to quantification and reporting of among-study variation

PHS435 Preparing datasets for analysis

*2*Cr. Hrs. (*1*LCT+ *0* TUT+*3*LAB+ *0* OTH) - SWL=*135*– ECTS =*5*

Prerequisite: PHS232

This course distils expert knowledge and skills mastered by professionals in Health Big Data Science and Bioinformatics. Students will learn exciting facts about the human body biology and chemistry, genetics, and medicine that will be intertwined with the science of Big Data and skills to harness the avalanche of data openly available at your fingertips and which we are just starting to make sense of. It will investigate the different steps required to master Big Data analytics on real datasets, including Next Generation Sequencing data, in a healthcare and biological context, from preparing data for analysis to completing the analysis, interpreting the results, visualizing them, and sharing the results.

PHS436 Outbreak Investigation

3 Cr. Hrs. (1LCT+ 2 TUT+3LAB+ 0 OTH) - SWL=150 – ECTS =5

Prerequisite: PHS315

The focus of this course is on understanding routine and unusual disease outbreaks and the application of methods for their detection and investigation and control in resource limited and developed settings. The course uses case studies to teach epidemiologic disease pattern recognition, identification of aberrant patterns, and interpretation of epidemic and surveillance data to inform outbreak investigation and disease control. The course explores a number of outbreaks from around the world in case studies, lectures, discussion forums, webinars, and readings to teach principles of outbreak detection, verification, investigation, communication, and control. You will learn about outbreak data analysis and interpretation, outbreaks in vulnerable populations as well as the role of the laboratory.

PHS437 Psychosocial Epidemiology

2 Cr. Hrs. (*1*LCT+ *2* TUT+0LAB+ *0* OTH) - SWL=*150* – ECTS =*5*

Prerequisite: PHS134

This course provides an overview of psychosocial trauma and recovery processes at the community level, explores social disorders of public health importance and their wide implications. The course also covers quality of life concepts and the development and use of quality-of-life questionnaires. This course also explains the basics of community development and participatory approaches when collaborating with communities.

PHS438 Qualitative Research

3 Cr. Hrs. (*1*LCT+ *2* TUT+*3*LAB+ *0* OTH) - SWL=*135* – ECTS =*5*

Prerequisite: None

This course teaches the students how to conduct qualitative research, various methods of qualitative data collection, practical interviewing and focus group skills, different methods of qualitative data analysis including grounded theory, discourse analysis, IPA, and thematic framework analysis.

PHS439 Evidence Based Practice

2 Cr. Hrs. (*1*LCT+ *2* TUT+*0*LAB+ *0* OTH) - SWL=*135* – ECTS =*5*

Prerequisite: PHS434

This course is designed to teach evidence-based practice (EBP) skills that will enable staff to conduct extensive evaluations of existing literature to improve patient care. The students learn to explain the origins, processes an application of evidence based healthcare practice in the students area of practice, demonstrate how to develop PICO style questions for the implementation of evidence based healthcare process, discriminate between the different types and levels of evidence, describe the strengths and deficiencies of each, construct literature

search strategies, critically appraise research articles and articulate methods to combine evidence in the production of guidelines and recommendations.

PHS441 Research Methods in Health Administration

4 Cr. Hrs. = (***3*** LCT + ***0***TUT + ***2*** LAB) - SWL = ***165*** – ECTS =***6***

Pre-requisites: PHS 236, PHS 231

The course builds on an earlier introduction of research methods and provides students with the higher-level knowledge and skills needed to critically review, use, and conduct research. It provides a comprehensive overview, in relation to health administration, of theoretical underpinnings of research; the asking of research questions; literature reviews; the design, implementation and appraisal research on operational efficiency of health establishments and the consequent expectancy effects that may produce biases like the Hawthorne experiments.

PHS442 Human Resource Management in Health Systems

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***0*** LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: None

This course builds upon earlier courses of workplace safety and psychology of the workplace, emphasizing the various functions of human resource management in the context of health systems, including compensation and benefits, staffing, recruitment and selection, research, labor relations, training and development, health and safety, planning, mediation and arbitration, the influence of government legislation on industry, and human rights legislation and employment equity.

PHS443 Project Management in Health Systems

3 Cr. Hrs. (***2***LCT+ ***2*** TUT+ ***0***LAB) - SWL=***150***– ECTS =***5***

Pre-requisites: None

This course provides a systematic and thorough introduction to all aspects of project management. Projects are an increasingly important aspect of modern business. Therefore, the course underlines the importance of understanding the relation between projects and the strategic goals of the organization. The course also discusses the technical, cultural, and interpersonal skills necessary to successfully manage projects from start to finish. It emphasizes that project management is a professional discipline with its own tools, body of knowledge, and skills. Concepts are reinforced by case studies covering a wide variety of project types related to health services. Focusing on the introduction of new products and processes, it examines the project management life cycle, defining project parameters, matrix management challenges, effective project management tools and techniques, and the role of a project manager.

PHS444 Interprofessional Collaboration

3 Cr. Hrs. = (***3*** LCT + ***0***TUT + ***0***LAB) - SWL = ***150*** – ECTS =***5***

Pre-requisites: None

This course brings together students with diverse health sciences backgrounds including healthcare administration, health informatics, nutrition, and global health to work collaboratively to learn the fundamentals of policymaking as applied to public health program planning and evaluation. This course is designed to provide students with an overview of the steps needed to plan, implement, and evaluate public health programs. Students then work in interprofessional groups to identify a public health problem, describe the context, map potential solutions, and plan a pilot public health program before making a

comprehensive report that builds upon expertise from interprofessional peers.

PHS445 Professional Practice Internship

6 Cr. Hrs. = (**6** LCT + **0**TUT + **0**LAB) - SWL = **105**– ECTS =**4**

Prerequisite: PHS 360

This course allows students to gain experience, apply knowledge and skills, and gain professional competence and confidence by completing health administration-related experiences under the supervision of preceptors. Typically, this internship takes place in an approved health system that prepares the student to function within a hospital, health-system, or a similar setting. Given the variability of required experiences and sites, the day-to-day activities of the student will depend on the preceptor but must include core tasks to be defined in the syllabus.

PHS451 Diet and Meal Planning

2 Cr. Hrs. = (**1** LCT + **0**TUT + **3**LAB) - SWL = **120** – ECTS =**4**

Prerequisite: PHS211

Diet planning principles and dietary guidelines are key concepts in selecting foods when formulating diets for individuals in order to achieve and support optimal health. Food groups and the nutritive values of different types of foods are important tools in selecting foods for planning an adequate balanced diet. The course aims at giving the student the principles of diet and meal planning in order to be able to construct diets used in the nutritional care of various physiological and pathological states.

PHS452 Nutrition and Non-Communicable diseases

2 Cr. Hrs. = (**2** LCT + **0**TUT + **0** LAB) - SWL = **105**– ECTS =**4**

Prerequisite: PHS351

The course focuses on the role of nutrition in the development of non-Communicable diseases such as diabetes mellitus, cardiovascular diseases, cancer, and obesity. The course emphasizes the increasing prevalence of non-communicable diseases in developing and developed countries, the factors enhancing the prevalence and the role of nutrition in the prevention and treatment.

PHS453 Clinical Nutrition 2

3 Cr. Hrs. = (**2** LCT + **0**TUT + **3**LAB) - SWL = **165** – ECTS =**6**

Prerequisite: PHS356

This course integrates knowledge of pathophysiology of selected diseases with nutrition interventions and prevention of various disease states. Students are introduced to the skills required to plan and implement modified diets for selected medical conditions. The course incorporates understanding, and application of dietary modifications while considering the physiological, psychological, and social aspects of the individual. Course topics include obesity, cardiovascular disease, diabetes, cancer, renal disease, gastrointestinal diseases, and Nutrition Support.

PHS454 Food chemistry and analysis

3 Cr. Hrs. = (**2** LCT + **0**TUT + **3**LAB) - SWL = **150** – ECTS =**5**

Prerequisite: None

This course highlights the importance of studying chemistry of food components and chemical reactions that take place in the biological system. This course covers different topics including water in biological system, proteins and amino acids, carbohydrates and sugars and

volatile compounds. Chemical reactions that take place in biological systems include enzyme and nonnon-enzyme reactions, oxidation of food and flavor reactions. The chemical changes in the composition of food under various circumstances such as storage or processing will be discussed. This course also introduces the theory and practice of the analysis of food composition and characteristics. Techniques and instrumentation used for the analysis of foods including spectroscopy, chromatography, and titration will be explored.

PHS455 Nutrition Seminar

2 Cr. Hrs. = (***1*** LCT + ***2***TUT + ***0***LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: SENIOR STANDING

Reading and preparation of a paper and oral presentation on a selected subject in nutrition. This seminar provides a forum for discussion of topics of current relevance to students preparing for a career in nutrition. The final written paper should be appropriate for publishing in a relevant scientific journal.

PHS456 Food Technology

3 Cr. Hrs. = (***2*** LCT + ***0***TUT + ***3***LAB) - SWL = ***150*** – ECTS =***5***

Prerequisite: None

The course focuses on current food technologies and processing methods and the factors affecting the palatability and nutritive value of human foods. recent developments and applications of modern genetics as well as enzyme, cell, tissue, and organ-based biological processes to produce and improve foods, food ingredients, and functional foods will be emphasized. Other areas of strong interest are fermentation to improve foods, food ingredients, functional foods, and food waste remediation. The course includes field visits to food processing establishments.

PHS457 Malnutrition and Nutrition Interventions

2Cr. Hrs. = (***2*** LCT + ***0***TUT + ***0***LAB) - SWL = ***105***– ECTS =***4***

Prerequisite: PHS351

The course deals with malnutrition as a spectrum of health problems including under nutrition at one end of the spectrum and over nutrition at the other end. The course will concentrate on macronutrient deficiencies and micronutrient deficiencies, the students will examine the aetiology, symptoms and diagnosis of the nutrition deficiency diseases prevailing in the community. As well as the nutrition interventions for the management, prevention, and control of these problems.

PHS458 Capstone Project

4 Cr. Hrs. = (***0*** LCT + ***0*** TUT + ***12*** LAB) - SWL = ***180*** – ECTS =***7***

Prerequisite: SENIOR STANDING

Students use their previous learning and acquire skills to develop, implement and analyze a public health project in their area under the guidance of a faculty staff member. The students may work singly or in groups and may collaborate with other students of the Faculty of Public Health from different specialties.

PHS459 Nutritional Genomics

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB) - SWL = ***90*** – ECTS =***3***

Prerequisite: None

This course introduces nuclear receptors and their mechanisms of action, nutritional control of gene expression and functional genomic studies with relationships to nutrient intake and polymorphisms.

PHS461 Genetic Susceptibility to Disease

3 Cr. Hrs. (***1***LCT+ ***2*** TUT+***3***LAB+ ***0*** OTH) - SWL=***150***– ECTS =***5***

Prerequisite: PHS361, PHS364

This course explores the various types of mutations and their role in disease. Topics covered include germline and somatic mutations, types of length mutations and single nucleotide polymorphisms (SNPs), how mutations are inherited and how they predispose to disease. Examples covered include BRCA1 and BRCA2 discovery, their role as tumor suppressor genes, epidemiology, and guidelines regarding their mutations.

PHS462 Data Analysis in Genetic Studies:

3 Cr. Hrs. (***1***LCT+ ***2*** TUT+***3***LAB+ ***0*** OTH) - SWL=***150***– ECTS =***5***

Prerequisite: PHS338 OR PHS364

The course is intended to give an understanding of concepts and methods related to analysis of genetic epidemiology data with focus on both family-related linkage analysis and population-based association studies. We will explain general concepts of genetic epidemiology, and demonstrate practical methods and tools needed for different kinds of genetic data. In the hands-on parts of the course, we will focus on the software PLINK (for association) and Merlin (for linkage analysis). For population-based association studies, the course will cover analysis of qualitative and quantitative traits, multifactorial analysis of SNPs: (logistic) regression, likelihood-ratio test. etc. and multiple testing. The course will also cover parametric Linkage-Analysis; pedigrees and inheritance modes of Mendelian diseases, LOD scores, two-point and multipoint analysis, power analysis for linkage, and clinical aspects of linkage analysis. The course will provide a focus on applications relevant to Public Health.

PHS463 Genetic Risk Assessment and Counselling

3 Cr. Hrs. (***1***LCT+ ***2*** TUT+***3***LAB+ ***0*** OTH) - SWL=***150***– ECTS =***5***

Prerequisite: PHS364, PHS235

This course introduces the web of causality in relation to genetic variation, gene x gene interaction, gene x environment interaction, heritable disorders, premarital counselling, familial cancers, counselling the cancer patient.

PHS464 Targeted Drug Development and Pharmacogenomics

3 Cr. Hrs. (***1***LCT+ ***2*** TUT+***3***LAB+ ***0*** OTH) - SWL=***150***– ECTS =***5***

Prerequisite: PHS361, PHS364

This course follows the process of drug discovery from target identification throughout target validation and development of the lead candidate, the concept of companion diagnostics and developing drugs for specific targets, the delivery of the drug to the target, and the concept of personalized medicine, how genetic factors can influence response and toxicity of a drug. Pharmacoepidemiology is introduced and discussed in relation to specific drugs. The course will provide a focus on applications relevant to Public Health.

PHS465 Future Healthcare Models

2 Cr. Hrs. = (***1*** LCT + ***2*** TUT + ***0*** LAB) - SWL = ***105*** – ECTS =***4***

Prerequisite: None

This course explores the 4P healthcare model and previous models including the biomedical model, the biopsychosocial model, the evidence-based model, and the patient centered model. The course introduces the four components of the modern healthcare model; preventive, predictive, personalized, and participatory and how the future progress of public health is aligned to these developments. The

concept of personalized medicine is introduced with focus on its preventive and predictive components. The recommendations and guidelines focusing on the introduction of public health genomics into routine healthcare are discussed.

PHS466 Predictive Multigene Assays

2 Cr. Hrs. (***1***LCT+ ***2*** TUT+***0***LAB+***0*** OTH) - SWL=***150***– ECTS =***5***

Prerequisite: BMD310, PHS462

This course presents the development of predictive models based on non-genetic factors as the Gail model, the development of molecular diagnostics, the progression to predictive multigene assays based on tumor signature, the use of multigene assays in conditions other than cancer. The course will provide a focus on applications relevant to Public Health. Examples of assays used in primary, secondary and tertiary prevention will be used.

PHS467 Capstone Project

4 Cr. Hrs. (***0***LCT+ ***0*** TUT+***12***LAB+ ***0*** OTH) - SWL=***165***– ECTS =***6***

Prerequisite: Senior standing

Students will use their learning and skills experience to develop a genetic epidemiology project and execute it with the purpose of writing an integrative learning final paper, a thesis paper, under the guidance of a coordinator/advisor. Completion of this course, along with completion of the necessary credits, will result in the student obtaining their BPH.

PHS468 Introduction to Metabolomics

2 Cr. Hrs. (***1***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***135***– ECTS =***5***

Prerequisite: PHS364

This course introduces the basics of the field of metabolomics. Topics covered include an introduction to metabolomics, both targeted and untargeted approaches, experimental design and the importance of quality control samples in untargeted metabolomics, analytical strategies applied in metabolomics with a focus on mass spectrometry, hands-on laboratory sessions focused on sample preparation and to include metabolic quenching and extraction procedures, intracellular and exometabolome samples, and polar and non-polar extraction methods, hands-on laboratory sessions focused on sample analysis for untargeted metabolomics studies using an Acuity UPLC coupled to a Xevo QToF mass spectrometer, data processing and data analysis, an introduction to metabolite identification. The course will provide a focus on applications relevant to Public Health.

PHS469 Introduction to Experimental Biology

2 Cr. Hrs. (***1***LCT+ ***0*** TUT+***3***LAB+ ***0*** OTH) - SWL=***105***– ECTS =***4***

Prerequisite: None

This course provides a focused introduction to methods of biological experiments in the lab or animal studies, as opposed to human clinical and population research. It also covers ethics of using experimental animals.

PHS 499 Special topics in Public health

2-3 Cr. Hrs. (***2-3*** LCT+ ***0*** TUT+***0***LAB) - SWL=***135***– ECTS =***5***

Prerequisite: None

This course provides specific topics in public health to be identified by the instructors and approved by the program director and academic council.