Syllabi of the Modules in Revised Curriculum

B.Sc. Engineering Honours Degree Programme

Earth Resources Engineering Specialization

Department of Earth Resources Engineering

Code	**ER1952**	Title	**ENGINEERING DESIGN**			Non GPA
Credits		Hours/ Week	Lectures	02	Pre-requisites	EN101
			Lab/Tutorials	03	Co-requisites	EN196

Learning Outcomes

Upon successful completion of this module the students should be able to:

- Explain basic engineering design concepts
- Simulate the dynamics of a small design group
- Apply the knowledge gained to a design project resulting in a working prototype

Course Outline

Design Principles

Introduction to Engineering Design, life cycles of engineering products and processes, design processes and design tools, concurrent engineering, creativity and reasoning, analysis and synthesis, simulation, evaluation and decision making

Case Studies

Several simple but comprehensive design case studies selected from different disciplines of engineering addressing the topics ;

a). Design for manufacturing
b). Mechanical and material aspects in design
c). Electrical, Electronic and IT aspects in design

Design Assignments

Group based design assignments (Topics to be selected by Engineering Design Center in consultation with the department or proposed by the students groups). The project will include;

a). gathering of data and information from various sources as a preliminary to the design
b). preparing a work plan and delegating duties
c). working with others and to produce results by given deadlines and within given costs
d). learning the basic procedures required for conceptual, preliminary and detailed designs
e). learning the importance of the cost component in the manufacturing process
f). preparing a report and making a presentation on the work cone
g). demonstrating the working of the prototype

Assessment Scheme

Continuous assessments 60%

Final exam 40%

Module Code	**ER 1962**	Title	**SKILL DEVELOPMENT**			
Credits	**1.5**	Hours/ Week	Lectures	1.0	Pre-requisites	None
			Lab/Tutorials	6		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Write a CV
Make a power point presentation effectively
Write scientific reports

Course Outline
Mental readiness for engineering profession
Leadership skills
Scientific writing
Presentations: Making a presentation after perusing a technical paper, inclusive of the use of power point and submission of written summary
CV writing and how to find the job you want
Negotiation skills
Personal grooming and table manners

Assessment scheme
Continuous assessments 100%

Module Code	**ER 1012**	Title	**GEOLOGY**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain the basic concepts in geology

Course Outline
General geology – Origin of the Earth, interior structure of the Earth, rock cycle
Physical geology – Endogenic and exogenic processes of the earth
Crystallography – External characteristics, symmetry, and crystallographic systems
Mineralogy – Classification and identification of minerals using physical properties

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 2032**	**Title**	**GEOPHYSICS**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain and compare the basics of geophysics and techniques

Course Outline
Introduction to geophysics
Geophysical methods
- Gravity
- Magnetic
- Seismic
- Electromagnetic
- Electrical Resistivity
- Self- Potential
- Induced-Polarization, and Gamma-ray Spectrometry
- Ground Penetrating Radar (GPR)

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 1032**	Title	**ANALYTICAL METHODS**			
Credits	**2.0**	Hours/ Week	Lectures	1.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Perform basic statistical analysis of analytical data arising from chemical analysis
Effectively use literature and handbooks
Practice general laboratory techniques
Perform basic instrumental analysis on spectrophotometer and AAS

Course Outline

Accuracy & precision, standard deviation, variance, coefficient of variation, minimization of errors, sampling

General laboratory techniques:

Sampling of rocks, minerals, ores, water and effluents
Minerals/ores dissolution techniques: Solution preparation for gravimetric, volumetric and spectroscopic methods

Instrumental Analysis: [including theory and sample preparation as applicable] Atomic absorption , Micro probe, Electron Microscopy, X-Ray (XRD), flame photometry, Gas chromatography

Nuclear Techniques:

Handling of radioactive minerals, safety aspects, alpha, beta and gamma ray counting techniques. Determination of half lives ($t_{1/2}$) and identification of radioisotopes

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 2642**	Title	**ENVIRONMENTAL ENGINEERING CONCEPTS**			
Credits	**3.0**	Hours/ Week	Lectures	2.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Summarize in writing the causes of environmental pollution and how to minimize or prevent them

Perform basic field sampling and laboratory analysis of water quality

Summarize in writing the responsibilities of the engineering profession in the society and environmental ethics

Perform a basic cleaner production audit

Course Outline

Basic methods and principles in Environmental Engineering.
Introduction to environmental pollution.
Engineering and Environmental ethics.
Laboratory analysis and field sampling techniques for Environmental Engineers including safety aspects.
Introduction to cleaner production.
Introduction to sustainable development.
Introduction to ecological engineering.

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 2012**	Title	**OPTICAL MINEROLOGY AND PETROLOGY**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Identify minerals using optical properties

Classify and identify rocks

Course Outline

Optical mineralogy
Introduction to Petrology
Igneous Petrology
Sedimentary Petrology
Metamorphic Petrology
Petrographic analysis
Geology of Sri Lanka

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 2412**	Title	**INTRODUCTION TO OCEANOGRAPHY**			
Credits	**3.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials	-		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain the basic concepts of oceanic processes required for a mining engineer
Compile various engineering applications of oceanic processes
Explain the physicagraphy and the origin of the ocean
Discuss ocean related disaster management and mitigation, especially with respect to tsunami

Course Outline

The Growth of Oceanography

Oceanography: What is it?, historical review of Oceanography, early scientific investigations modern oceanography, interdisciplinary oceanic research, use of complex scientific instruments, and Current and Future Oceanographic Research.

The Planet Oceanus

The Earth's Structure, Three fluid spheres surround the rocky portion of the Earth. The Physiography of the Ocean Floor, Geologic Differences between Continents and Ocean Basins, Isostasy.

Origin of Ocean Basins

Continental Drift, Sea-Floor Spreading, The geomagnetic field, Global Plate Tectonics, Wilson Cycle.

The Properties of Seawater I

Basic Chemical and Physical Notions of water, composition of sea water (major constituents, Nutrients Trace elements), Salinity (Principle of constant proportion, Salinometers, etc.), Salt sinks, changes of properties of sea water due to salts.

Structure of the Oceans

Sea Surface Temperature (SST), thermocline, salinity, halocline, density, Pycnocline., Gases in Seawater, Chemical Techniques, Desalinization, Amount of light penetration . The speed of sound in sea water.

The Human Presence in the Ocean

Pollution, Hydrocarbons in the Sea, Municipal and Industrial Effluents, Ocean Dredging and Mining, Mining of deep ocean, Over fishing, Climate Change, The Ocean's Future.

Marine Productivity

Global Patterns of Productivity, Biological Productivity of Upwelling Water, El Niño results in primary productivity

Waves in the Ocean I

Properties of Ocean Waves, wind-generated waves, Wave Motions, Life History of Ocean Waves. Wave steepness.

Management and Mitigation of Ocean related Disasters

Tsunami, storm surges, their origin, inundation, forecasting, and tsunami modeling.

Student Presentations:

Students should present a short presentations on current problem related to ocean

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 2022**	Title	**MINERAL AND GROUND WATER EXPLORATION**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Properly collect field data/ samples related to mineral resources and groundwater
Process and interpret data of different exploration techniques

Course Outline

Geochemical techniques:
Introduction to geochemistry
Geochemical environments
Optimization and planning
Geochemical mineral exploration techniques
Geochemical surveys
Data analysis (geostatistics, geothermatic maps, color contouring)

Geophysical techniques:
Application of geophysics in mineral and ground water exploration
Geophysical field surveys and setting up apparatus
Analysis, Modeling and interpretation of geophysical data

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 3052**	Title	**STRUCTURAL AND FIELD GEOLOGY**			
Credits	**2.0**	Hours/ Week	Lectures	1	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Identify and explain various geological structures and rock types.

Course Outline
Basic geological structures and deformational features of rocks
Bedding
Foliation
Folds
Faults
Joints
Principles of geological mapping
Deformational features and history of Sri Lankan rocks

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 2512**	Title	**GEMMOLOGY**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Handle gemological equipment properly.
Identify gems using crystal formations and gemological properties

Course Outline
Introduction:
Essential qualities of gems, origin of gemstones, classification of gemstones.

Crystallography:
Crystal systems, symmetrical elements and crystal parameters, common crystal forms, twinned crystals, polycrystalline and microcrystalline minerals, Metamict minerals

Determination of Physical and optical propertiesusing:
Hand lens, Polarisecope, Conoscope, Refractometer, Spectroscope, Dichroscope and Microscope

Properties and Methods of identification of following gemstones:
Beryl, Corundum, Crysoberyl, Diamond, Diopside, Feldspar, Jadeite and Nephrite, Natural glass, Opal, Peridot, Quartz, Topaz, Tourmaline, Zircon and Zoisite
Man made gems : Synthetics, Artificial products and composites
Synthetic gemstones: Flame fusion (Vernueil) process, Czochralski method, flux melt growth, skull melting method, zone melting method, Hydrothermal method, Diamond synthesis.
Organic gem materials: Pearl, coral, amber, ivory, tortoiseshell, shell, jet.

Advanced techniques of gem and inclusion identification:
Electron microprobe, Scanning electron microscope, Ultraviolet-visible and near infra red spectrometry (UV-vis-NIR), Secondary ion mass spectrometry (SIMS), Fourier-transform infrared (FTIR) spectrometer, Raman spectrometer, Energy Dispersive X-ray fluorescence (EDXRF), Laser Ablation-Inductively Coupled Plasma-mass spectrometry**.**

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 2312**	Title	**PRINCIPLES OF RS AND GIS**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain concepts of Remote Sensing, GIS and GPS and their specific usage in Earth Resources Management.

Interpret satellite images and aerial photographs visually.

Scan, geo-reference and digitize features on hard copy of images.

Course Outline

Concepts and introduction of Remote Sensing
Introduction to Aerial Photogrammetry
Introduction to Satellite Remote Sensing
Introduction to GIS
Basics of GPS

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 2042**	Title	**ROCK BLASTING AND MINE DEVELOPMENT**			
Credits	**3.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Design and implement rock blasting systems for surface and underground workings.
Handle explosives safely.
Carry out blasting in an environmental friendly manner.
Plan and execute a development plan for a mine.

Course Outline

Rock blasting

Drilling methods and techniques:
Surface blast hole drilling, Equipment, Selection of equipment, Drilling tools.

Properties and selection of explosives:
Properties, Types of explosives/Blasting agents, Mechanics of detonation, Detonators and types of detonators, delay systems, Safe handling, Storage, loading, transportation and circuit testing.

Blasting accessories:
Types, capacities

Blasting practices:
Basics blast design principles, Open pit blasting, underground blasting, free splitting, smooth Wall blasting, under water blasting, building demolishing and non explosives demolishing, Fragmentation analysis, charging blast holes, methods of ignition techniques, blast circuits.

Environmental aspects of blasting:
Blast damage criteria, control of noise, vibration, air blast and fly rocks.

Mine Development

Establishments of infrastructures.. power and water supply, access roads, accommodation, education , recreation and security, Methods of opening a deposit.. adit, shaft(vertical, inclined)

Blasting patterns, cut holes, charging, blasting, mucking, temporary support, permanent support and services for tunneling, shaft shrinking, raises and winzes.

Shaft shrinking under difficult conditions.. frizzing, concreting

Subsidence

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 3012**	Title	**MINERAL ENGINEERING – I**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain and compare basic physical separation methods as applied to value addition of minerals (mineral processing).

Design mineral processing and physical separation plants using run of mine raw material and control plant parameters for optimum value addition.

Course Outline

Comminution:

Crushers, Grinding mills, Theory of comminution , Kick's law, Rittinger's law, Calculation of Bond and Work index, Factors controlling comminution.

Sieving:

Types of screens, efficiency screening, factors affecting the efficiency, closed circuit crushing and grinding and simple flow charts using the above.

Flow properties of minerals through orifices:

Silos, Repose angle measurements

The movement of solids in fluids:

Stoke's law, Newton's correction, Rittinger's equation, Reynolds number, Ratios of concentration, Recovery,

Theory of hydro cyclones, hydro cyclone designs, performance curves, flow sheets and applications of hydrocyclone in specific mineral separations.

Industrial applications of Thickeners, Jigs, Tables, Sluices and Classifiers; all supported by industrial visits.

Magnetic Separation and High-Tension Separation:

Magnetic permeability, magnetic susceptibility, magnetic separators- wet and dry separation, high-tension separation, effect of variables and controls (particle size, moisture content, inclusions and their effect on the Recovery).

Filtration:

Darcy's equation ,Use of filter presses as a dewatering method, Disk & Drum filters the factors affecting filtration

Drying:

Types of dryers, dryer conveyors, types of kilns, firing techniques, Kiln lining materials (Refractories).

Micromeritics:

Characterization of particles, graphical representation of centre grain size and quartile ratio, particle size measurements- Andreason pipette method , Hydrometer method centrifugal method)

Assessment scheme

Continuous assessments 30%

Final exam 70%

Module Code	**ER 3022**	Title	**MINE SURVEYING**			
Credits	**2.0**	Hours/ Week	Lectures	1.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Utilize 3-D view of underground and open pit mining
Transfer of coordinates in an underground and open pit mining.
Create plan and elevation views of an underground mine and an open pit mine.

Course Outline

General:

Mine Surveying and its relation to adjacent disciplines.

An introduction to Mining Geometry:

Projection with numerical point heights.

Surface reference nets, mine surveying maps, plans and profiles:

Surface control for underground surveys.
Miner's plans.
Field books and notes used in mine surveying.

Surveys of underground workings:

Underground mining reference and survey nets.
Measuring vertical and horizontal angles in underground workings.
Measuring underground Theodolite traverse lines.

Vertical surveys in underground workings.

Direct leveling.
Indirect leveling.

Connection Surveys.

Mine surveying operation in open pits.

Draw Plan ,Elevation and 3-D views an underground as well as open pit mine using AUTOCAD software

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 3032**	Title	**MINING METHODS**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain suitable mining methods to extract a mineral deposit

Course Outline

<u>Surface mining methods:</u>

Mining of placer deposits.

Mining of mineral deposits at shallow depths:
Introduction to mineral deposits at shallow depths and their properties.
Methods used for open cast mining.
Machinery and equipments used for open cast mining.
Problems associated with open pit mining.
Environmental Impacts and reclamation work.

<u>Underground metalliferous mining:</u>

Introduction to the classification of ore deposit mining systems, terminology and guidelines for selecting a proper mining method.
Different underground mining methods.. cut and fill, shrinkage, open stope, cave and room and pillar. Their applications advantages and disadvantages.

Underground coal mining:
Types of mines, Types of mining systems (conventional, continuous, boring, ripper, milling or drum type), Longwall system, Shortwall system.

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 3042**	Title	**MINE MACHINERY AND DESIGN OF MINERAL TRANSPORT SYSTEMS**			
Credits	**3.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Select suitable machinery and vehicles for mining and transport of minerals.

Course Outline

Underground machineries :

- Machines used in development and extraction of hard mineral mines, Machines used in, development and extraction of Coal mines
- Mine hoists
- Mine communication
- Remote controlled systems

Open pits:

- Machines used in open cast mines and quarries for development and ore extraction
- Machines used in exploitation of ore bodies below the water table
- Machines used in hydraulicking
- Offshore mining machines

Mineral transport:

- Underground transport:
  - Underground mines : Locomotive haulage and mine cars, dump trucks, loaders, LHDs and special transport machines, conveyors, rope haulage, hydraulic transport, wire ropes, mine hoists, non destructive testing of wire ropes and their applications
- Open pits :

Open pit mines: Locomotive haulage, truck haulage, conveyors, rope haulage and hydraulic transport

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 3412**	Title	**COASTAL OCEANOGRAPHY**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain the wave dynamics that shapes the coastal zone.

Explain morphodynamics of coastal areas.

Course Outline

Properties of Sea Water II

Chemical and Physical Structure of the Oceans, latitudinal relationship related of Salinity to precipitation and evaporation, Density of seawater is a function of temperature, salinity and pressure. The water column in the ocean can be divided into the surface layer, pycnocline and deep layer.Gases in Seawate, The Ocean as a Physical System, The Ocean Sciences: Chemical Techniques

Waves in the Ocean II

Standing waves, wave refraction, reflection and deflection

Tides:

Tidal Characteristics, Equilibrium Theory of Tides (Tidal Bulges, Earth's rotation, the monthly tidal cycle, neap and spring times.), Dynamic Theory of Tides (amphidromic points and cotidal lines), tidal energy

Ocean Atmosphere Interactions

Wind circulation (Solar insolation, Coriolis deflection, Hadley cell, Ferrel Cell, Polar Cell), surface ocean currents, Eckman Spiral, Geostrophic flow, Gyres), Deep Ocean Circulation (Thermohaline circulation)

The Dynamic Shoreline and coastal protection

Coastal Water Movement (Breaking waves, wave shoaling, longshore currents), Beaches (beach profiles (storm and swell), sand budget), coastal dunes (morphology, vegetation, dunes as a natural barrier), Barrier Islands, cliffed coast, deltas, impact of people on the coastline.

Estuarine process:

Geomorphic classification, Energy classifications, Hydrodynamic classification, (salt wedged, partially mixed well mixed), gravitational circulation, stratification and mixing, lagoons, salt marshes, mangrove swamps, coral reefs.

Ocean Hydrodynamic Modelling

Concepts of numerical modeling (Model types, Model forcing, Model validation), Preparation of bathymetric maps, Coastal Systems, Case Studies

Assessment scheme

Continuous assessments 30%

Final exam 70%

Module Code	**ER 3312**	Title	**DIGITAL IMAGE PROCESSING AND PHOTOGRAMMETRY**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
- Enhance and classify digital images.
- Develop digital elevation models.
- Interpret digital photos, and be familiar with software.

Course Outline
Digital image concepts
Image rectification and restoration
Image enhancement
Image classification
SAR image processing
Hyperspectral image processing
Digital Photogrammetry- fondamental and processing techniques

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 3212**	Title	**WASTE WATER TREATMENT**			
Credits	**3.0**	Hours/ Week	Lectures	2.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
- Perform laboratory analysis of wastewater quality.
- Identify the characteristics of waste water and determine the type of treatment method needed for water quality improvement.
- Design a treatment process.

Course Outline
Sources of waste water
Characteristics of waste water
Waste Water collection.
Treatment processes:
- Physical treatment methods
- Biological treatment methods
- Chemical treatment methods

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 3222**	Title	**INDUSTRIAL MINERALS AND ECONOMIC GEOLOGY**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain formation and occurrence of mineral deposits and their industrial uses.
Describe Sri Lankan mineral deposits.
Explain mineral hazards.

Course Outline

Introduction to economic geology:

- Genesis and formations of economic mineral deposits
- Classification of mineral deposits.
- Methods of evaluation of economic mineral deposits.
- Identification of economic mineral deposits.
- Analysis of mineral deposits.

Classification of mineral deposits
Structural features of mineral deposits
Classification of industrial minerals and their uses
Formation of economic mineral deposits
Economic mineral deposits of Sri Lanka
Mineralogical Hazards

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 3512**	Title	**JEWELLERY PRODUCTS DEVELOPMENT**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Sketch Jewellery items, produce technical drawings and rendering.
Carry out Jewellery designs using JewelCAD software.
Carve a ring out of wax.

Course Outline

Jewellery Sketching, , technical drawing, principles of Jewellery design, theory and practice of Jewellery designs, design and culture, Jewellery Design using JewelCAD
Proto-typing – Wax carving, master model making, CAM
Markets – Domestic market, international markets, market segments, supply chain, product distribution

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 3232**	Title	**EXTRACTION METALLURGY**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain and compare the basic extraction processes for ferrous and non ferrous industries.
Explain the type of furnaces / kilns their design aspects, and the limitations.
Confidence to work in an extraction metallurgical plant

Course Outline

Principles of extraction metallurgy:
Pyro-metallurgy, Hydro-metallurgy, Electro-metallurgy.
Classification of metallurgical furnaces, review of various types of refractories used, High temperature measurement techniques. Principles of heat transfer in furnaces, Slag metal reactions.
Simple binary phase diagrams, Slag attack on refractories and other refractory failures.
Conventional blast furnace for ion making, temperature distribution of various zones in the furnace.
Zone refining and the importance of Temp- Composition phase diagrams.

Non-Ferrous extraction metallurgy:
Non-ferrous extraction metallurgy with special emphasis to the extraction of Copper, Aluminum, Titanium, Lead and Zinc. Titanium and its alloys in industry.
Extraction metallurgy of precious metals (Gold, Silver, Platinum).

Electrometallurgy:
Butler – Volmer equation, factors affecting electrochemical reactors, metal production, concept of over-potential , metal purification especially, Aluminium, Copper .
The economic characteristics of Electro metallurgical processes.
Types of corrosion and prevention techniques.

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 3992**	Title	**INDUSTRIAL TRAINING**			
Credits	**6.0**	Hours/ Week	Lectures		Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Demonstrate the nature of the industry and develop talent and attitude.
Recognize and demonstrate the responsibilities as a professional engineer in the future.
Analyze real life situations in the industrial organizations and their related environments.
Demonstrate the learning process of how the knowledge attained could be used in a realistic way.
Develop ability to make sound judgment.
Practice engineering activities in a feasible way with financial and economic limitations.
Analyze formal and informal relationships in an industrial organization so as to promote favorable human relations and team work.
Explain the problems encountered in the industry and select the optimal solution from the many alternatives available.
Perform basic laboratory tests.
Practice industry safety practices and explain such requirements and their appropriateness.

Course Outline

- Study and gain experience in organizations involved in mining, mineral processing, mineral exploration, rock engineering, tunneling, ground water, oceanographic work, RS & GIS and gem and Jewellery
- Study and gain experience in the worksite procedures, equipment and plants used and procedures adopted to get maximum benefits.
- Study the environmental impacts associated with such activities.
- Study and gain experience in activities related to research in such activities.
- Study and gain experience in legal aspects involved in such activities.

Assessment scheme

Report on Industrial Training; Daily Diary; Attendance and conduct during the period of training and the observation of the supervisors.
Oral examination

Module Code	**ER 3912**	Title	**GEOLOGY FIELD CAMP**			
Credits	**1.0**	Hours/ Week	Lectures		Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Use various geological field techniques.
Identification of rocks and their structures in the field and map the structures.

Course Outline
Preparation for field programmes
Geological mapping in the field.
Structural mapping in the field.
Identification of rocks in the field area.
Identification of minerals in the field area.
Preparation of geological maps, reports and presentation

Assessment scheme
Continuous assessments 100%

Module Code	**ER 3932**	Title	**MINERAL AND GROUNDWATER EXPLORATION FIELD VISITS**			
Credits	**1.0**	Hours/ Week	Lectures		Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Handle geophysical equipment and identify sub-surface geological features using geophysical techniques in the field.
Use geochemical sampling techniques and identify different geochemical features of mineral deposits in the field.

Course Outline
Geophysical exploration:
Selection of the suitable geophysical techniques for the area
Conduction of the following geophysical surveys:
Resistivity survey
Magnetic survey
Interpretation of data
Preparation of reports and presentation

Geochemical exploration:
Planning for Geochemical surveys
Geochemical sampling
Preparation of samples for analytical work
Preparation of reports and presentation

Assessment scheme
Continuous assessments 100%

Module Code	**ER 3902**	Title	**INDUSTRIAL VISITS**			
Credits	**1.0**	Hours/ Week	Lectures		Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain the operational steps and safety measures in underground and open cast mines.
Draw and explain the process flow diagrams in mineral processing plants.
Identify mineral deposits through inspection.

Course Outline
Field visits to locations from among the following:
Underground mines
Open-cast mines
Quarries
Processing plants
Open deposits

Assessment scheme
Continuous assessments 100%

Module Code	**ER 3942**	Title	**OCEANOGRAPHY FIELD STUDIES**			
Credits	**1.0**	Hours/ Week	Lectures		Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Organize a field work program.
Manage safety issues.
Perform and explain sampling techniques.
Explain operation and maintenance of ocean equipments

Course Outline
Usage and data interpretation of marine instruments
Usage of Side Scan sonar
Eco sounder
Tide and wave gauges
Navigation GPS
Current Meters
Gravity corer
Grab Sampler
CTD (Conductivity, Temperature, Depth)

Assessment scheme
Continuous assessments 100%

Module Code	**ER 3922**	Title	**MINE SURVEYING FIELD CAMP**			
Credits	**1.0**	Hours/ Week	Lectures		Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Carry out surveying and leveling in a mine, and prepare the report.

Course Outline
Familiarization with surveying techniques and instrument used by the Mining enterprise.
Conducting of level survey underground.
Transferring of co-ordinates from one level to another sub level.
Preparation of report and presentation.

Assessment scheme
Continuous assessments 100%

Module Code	**ER 4032**	Title	**ENGINEERING GEOLOGY**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	0		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain the methodology in site investigations and preparation of proposal and reports.
Utilize concepts in geology for engineering applications.
Explain the basic concepts on geological disaster prevention, mitigation and preparedness.

Course Outline
Site investigation for engineering projects. Preparation of site investigation proposal and reports
Engineering application of geology in planning and construction of dams and reservoirs
Importance of geology in planning and construction of tunnels
Geological considerations involved in construction of roads, railways, bridges and buildings
Rocks and soils as an engineering and construction materials

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 4012**	Title	**ROCK MECHANICS**			
Credits	**3.0**	Hours/ Week	Lectures	2.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Determine properties of rocks for engineering applications.
Estimate stability of rock slopes.
Analyse stress around underground openings and estimate underground support requirements.

Course Outline
Rock mass classification, Physical and mechanical properties of rocks and their testing methods, Elastic and time dependent behavior of rocks, Rock slope instability, Theories of rock failure, Stress analysis of rocks, In-situ stress measurements, Stress around underground openings, Underground structures, Underground supports, Underground failures.

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 4022**	Title	**MINE VENTILATION**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain concepts of mine ventilation.
Explain the planning and carrying out of mine ventilation techniques.
Perform ventilation surveys and propose improvements.

Course Outline
Introduction to subsurface ventilation, Introduction to fluid mechanics and fundamentals of steady flow thermodynamics, Gases in the subsurface, Dust , Heat, Psychometry, Subsurface ventilation systems, Incompressible flow relationships, Ventilation network analysis, Ventilation surveys, Ventilation planning, Fan engineering.

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 4042**	Title	**MINERAL ENGINEERING – II**			
Credits	**3.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain chemical separation techniques in the recovery of minerals of higher grade from as-mined materials.

Explain the various complications arising from handling of mineral suspensions.

Design suitable processing plants using chemical processing techniques and apply modifications wherever necessary, fulfilling conditions for environmentally sound processing technique/s.

Course Outline

Chemical Processing :

Sintering and pelletizing of iron ores, pellet testing, flow sheets relevant to iron ore preparation

Stability of mineral suspensions, Rheology, zeta-potential, flocculation, selective flocculation and applications in mineral separation.

Theory of flotation, type of flotation cells, activation, depression, modification of mineral surface characteristics, and calculations.

Leaching of minerals:

Treatment of sulphide minerals, Arbeiter process, Sherritt Gordon process, Toth process, Bayer process and its economics.

Gold extraction using Activated Carbon , Gold Recovery methods ; Flow sheets .

Theory of Solvent Extraction , Solvent extraction with special reference to Copper and Uranium ores

Tailings and tailings disposal (Radioactive and Hazardous)

Ion exchange process as applied to rare earth separations. Types of iron exchangers (Cat ionic, Anionic)

Air pollution, water pollution and pollution control methods, design of an electrostatic separator.

Electroplate separator: theory, Applications in industry.

Physico-Chemical :

In-stream analysis with special reference to radio isotopes. Such as Californium-252 (gamma emitters), sample geometry.(Prior knowledge of Nuclear techniques is essential)

Assessment scheme

Continuous assessments 30%

Final exam 70%

Module Code	**ER 4052**	Title	**PETROLEUM ENGINEERING**			
Credits	**3.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

- Explain geological processes that produce hydrocarbon.
- Explain systems and significance of the timing of hydrocarbon generation.
- Explain basics of petroleum engineering, including well drilling, pressure control, and reservoir calculations.
- Discuss principles of porosity and permeability in natural systems.

Course Outline

Petroleum Geology

Geological processes that produce hydrocarbon systems,
Significance of the timing of hydrocarbon generation,
The nature of the different fluids in the subsurface

Petroleum reservoir engineering.

Basic concepts of reservoir engineering
Calculation of reservoir volumes

Properties of reservoir fluids.

Fluid pressure regimes **,** Darcy's law and applications

Characteristics of reservoir rocks.

Petroleum drilling.

Drilling process, Drilling onshore and offshore, Drilling rigs, Platforms

Well controlling

Kicks , Blowouts ,Terminology , Basic Well Control Calculations
Causes of Kicks, Kick Detection , Shut-In Procedures

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4312**	Title	**GIS AND SPATIAL STATISTICS**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3	**ER 3312**	

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain the analytical techniques to treat spatial data.

Manipulate and analyze spatial data and make final output maps using GIS techniques.

Course Outline

GIS technology
Spatial information
Database concept
Data quality
Errors and map projections
Spatial data analysis (vector and raster based)
Multi-criteria analysis
Network analysis
Decision support system

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4412**	Title	**MARINE MINERAL RESOURCES**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites **ER 3412**	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:

Explain the Law of the Sea.
Explain the conduct of offshore or on shore mineral exploration program.
Explain offshore mineral potential.
Recognize various offshore minerals.

Course Outline

Introduction
Ocean sedimentation, Why seabed mining, advantages/disadvantages of ocean mining, mineral markets, political situation, the types of ocean minerals, exclusive economic zone.

Deep Seabed politics
Law of the sea, UNCLOS III convention and alternatives: the views of governments and industry.

Minerals of the deep seabed,
Ferromanganese nodules and crusts, pollymetallic suphides, hydrothermal deposits

Sea water as an ore
Fresh water distillation, sodium chloride, bromine, Magnesium, Uranium

Placers and Seabed metalics
Seabed metalics, gold, tin, garnet, monazite, ilmanite, rutile, effects of sea level changes on placer deposits.

Construction aggregates and industrial sand
Formation occurrence, and resource potential

Industrial chemical material and Coal
phopharites, calcium carbonates (shells, coral, aragonite), sulfur, coal.

Petroleum:
Origin and occurrence

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 4212**	Title	**CONTAMINATED SITE REMEDIATION**			
Credits	**3.0**	Hours/ Week	Lectures	2.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

- Investigate and propose appropriate remediation techniques to treat contaminated soil or sediments.
- Perform a risk assessment for a contaminated site.

Course Outline

Complexity of Contaminated Subsurface Systems
Site Investigation Techniques
Soil Remediation Technologies:
- Physical Treatment Technologies
- Chemical Treatment Technologies
- Biological Treatment Technologies
- Others: Soil Washing & Surfactant Treatment

Risk Assessment
Case Studies

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4512**	Title	**JEWELLERY PRODUCTION TECHNOLOGY**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3	**ER 3512**	

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Melt metal and produce alloys

Perform wire drawing, soldering, welding, sawing, filing, and polishing

Prepare a rubber mould, inject wax patterns, carry out the investment procedure and burn-out procedure, and cast.

Course Outline

Alloying & Melting – Karatage & fineness, colour, physical and mechanical properties, alloy making, ingot casting, assaying, hallmarking;

Investment Casting - Rubber moulding, wax and tree assembly, investment, casting, defects and their control;

Joining Technology - Soldering, fusion welding, spot welding, tack welding, laser-welding, pressure welding;

Finishing Technology - Techniques, sawing, filing, abrasive grading systems, polishing process, mass production methods, matte and mirror finishing, indentation and beaded type textures, etching and electro finishing, setting gemstones;

Annealing and heat treatment - Principals and practice of annealing, metallurgy of precious metals, heat treatment of carat gold alloys;

Metal working technology - Metal working technology, handworking, rolling, wire-drawing, chain making, Jewellery making, Investment casting, electroforming, EDM (electrical discharge machining), die striking (stamping), Fabrication, CAM;

Electrolytic Processes - Electrolytic processes, techniques & materials, electroforming, electroplating, electro polishing;

Metal refining - Equipment, chemicals, processes, aqua regia process, formic acid method, precipitation methods, electrolytic methods, silver refining, gold refining, platinum refining, hazards, laws and regulations

Assessment scheme

Continuous assessments 30%

Final exam 70%

Module Code	**ER 4522**	Title	**FASHIONING OF GEMSTONES**			
Credits	**2.0**	Hours/ Week	Lectures	1	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Develop capability to manage Jewellery production units involving handmade Jewellery, casting, electroforming, EDM

Course Outline

Coloured Gemstone Fashioning : Gem cutting methods - Traditional (hanaporuwa), jam peg, universal faceter, robotic, tumbling, carving, laser.Cutting styles - Cabochon, bead, facetted, shapes (standard shapes and fancy shapes), cuts (step, brilliant, rose etc), invisible.

Manufacturing Processes - Sawing, drilling, forming, shaping, calibrating, faceting, polishing, orientation, machinery.

Diamond Fashioning: Manufacturing process - Cleaving, sawing, bruting, cutting, polishing, brilliant cut, girdling machinery.

Management aspects : Supply chain - Local and international supply chain, of gem cutting:
Management and control - Production systems, mass production systems, factory and workshop organizing, productivity. management, information systems

Quality Assurance: Attributes, standards, international conventions, inspection and reports.

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4062**	Title	**HYDROGEOLOGY**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	0		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain the basic concepts of hydrogeology and groundwater exploration.
Carry out design of tube-wells and pumping tests.
Explain the concepts on chemical characteristics in groundwater and treatments.

Course Outline

Introduction to hydrogeology
Aquifers, aquifer properties, aquifer types and groundwater environments
Groundwater exploration – geological, geomorphological and geophysical methods
Well drilling
Design of shallow and deep tube-wells
Water pumps
Pumping tests (well and aquifer)
Chemical characteristics of groundwater
Groundwater treatments

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4072**	Title	**MINERAL ECONOMICS**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Plan and implement a sampling programme.
Estimate ore reserves from field data.
Assess the market condition for mineral products.

Course Outline

Sampling: Underground sampling methods.
Sampling program designing & cost of sampling, Sampling reduction procedures, Errors in sampling, salting, safeguard against salting
Sampling computations.
Cross-cut assays, Development heading assays, Narrow tabular deposits, Wide lenticular deposits.

Ore reserve estimation:
Introduction to ore reserves.
Ore reserve classification.
Methods of polygons and triangles.
Cross sectional methods.
Principal factors in the conversion of the in-situ to a recoverable reserve.
Geostatics

Mine cut-off grades:
Aspects of market value and costs.
Mineable widths.
Sample section width and complimentary minerals.

Marketability of mineral products:
Form of sale.
Market value.
Forms of contract sales and features of them.
Schedule of tariff.
Metal prices.
Market conditions for mineral products.

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4082**	Title	**MINE PLANNING AND DESIGN**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Carry out cost analysis on mine planning.
Accomplish mine optimization.
Select a suitable mining method according to facts/ conditions.

Course Outline

Mining method selection (geotechnical aspects), Mine life calculation, Principles of project Management, Mine capital investment..fixed capital, working capital, capital costs, and production costs, Time value of money..single payment present value, net present value (NPV),uniform series present value, capital recovery and sinking fund, Mine optimization (pit, dump and stope), Regulatory environment, site closure and environmental design, Equipment fleet selection, Benchmarking, Computer-aided mine design.

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4102**	Title	**MINE SAFETY AND LEGISLATION**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Identify hazardous situations and measures to prevent accidents.
Explain the requirement of safety gears and equipment.
Explain the response to accidents and carry out accident investigations.
Implement legislation related to mineral exploration and mining.

Course Outline

Mine safety

Types of accidents and hazards
Management's role in accident prevention.
General means and measurements for safety.
General conditions and rules of safety.
Accident prevention, analysis and investigation.
Mine rescue operation.
Personnel protective equipments.

Mine Legislation

Mines & Minerals Act, no 33 of 1992
Explosives Act.

Assessment scheme

Continuous assessments 30%
Final exam 70%

<table>
<tr><td>Module Code</td><td>ER 4422</td><td>Title</td><td colspan="4">MARINE EXPLORATION GEOPHYSICS AND OFF SHORE MINING</td></tr>
<tr><td rowspan="2">Credits</td><td rowspan="2">3.0</td><td rowspan="2">Hours/ Week</td><td>Lectures</td><td>2</td><td rowspan="2">Pre-requisites
ER 3412</td><td rowspan="2">None</td></tr>
<tr><td>Lab/Tutorials</td><td>3</td></tr>
<tr><td colspan="7">Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain the theoretical backgrounds of marine exploration techniques..
Discuss the methodologies to conduct various offshore geophysical surveys.
Familiarize with various advanced offshore mining techniques and relevant mining machinery.
Conduct a sidescan sonar survey.</td></tr>
<tr><td colspan="7">Course Outline
Seabed imaging by Sonar and Lidar
Seismic exploration at sea
The Marine Gravity Field
The Earth's Magnetic Field at Sea
Investigation of Seafloor using Electrical Methods
Seabed exploration using Radiometric Methods
Studies of the oceanic lithosphere
Offshore mining machinery and mining techniques
Discussion of case studies related to the above topics</td></tr>
<tr><td colspan="7">Assessment scheme
Continuous assessments 30%
Final exam 70%</td></tr>
</table>

Module Code	**ER 4242**	Title	**PETROLEUM PROCESSING**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain Kerogen and Petroleum composition.

Discuss the petroleum refinery processes and different characterization of petroleum fractions.

Discuss petroleum refinery products and their uses in various tasks

Course Outline

Petroleum Geochemistry

Kerogen, biomarkers, Type I, Type II, Type III and Type IV kerogen, kerogen maturity and hydrocarbon composition, petroleum composition, biodegradation of petroleum

Petroleum refining.

- Introduction to petroleum refining
- Petroleum refining process.
  Distillation Process- Atmospheric Distillation & Vacuum Distillation
  Conversion process - Cracking, Unification & Alteration
  Treating processes.- Desalting, Hydrotreating, Sulphur compounds extraction & Sweetening, Amine Plant, Solvent Treating
- Characterization of petroleum fractions

Major petroleum refinery products.

Motor gasoline
Diesel Fuel
LPG & LNG
Lubricants

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4322**	Title	**SPACE TECHNOLOGY AND NAVIGATION SYSTEMS**			
Credits	**2.0**	Hours/ Week	Lectures	1.5	Pre-requisites	None
			Lab/Tutorials	3/2		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain characteristics of space crafts and orbits.

Use satellite based navigation system.

Course Outline

Spacecrafts and orbits
GPS systems
Navigations systems
Satellite GDOP
Receivers
GPS errors
DGPS, Analysis of GPS data
GPS data processing
GLONASS, EGNOS, MSAS, and GALELIO SYSTEMS

Assessment scheme

Continuous assessments 30%
Final exam 70%

Module Code	**ER 4222**	Title	**CONSTRUCTION ENGINEERING PRACTICE**			
Credits	**3.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain the uses of various constructions materials.

Draw bending moment and shear force diagrams to analyze the behavior of structural elements (steel and reinforced concrete).

Read and interpret the specifications and structural drawings.

Course Outline

Construction materials (steel, timber, masonry, concrete).

Manufacturing process, selection, testing and properties of building material

- Bricks
- Rubble
- Sand
- Coarse aggregates
- Timber
- Roof cover material
- Cement blocks
- Cement
- Lime
- Concrete
- Steel
- New building Materials

Testing

Bending moment and shear force diagrams (simply supported and continuous beams, cantilevers, typical columns, and arches).

Bending stresses and shear stresses in a steel member and a reinforced concrete member.

Typical construction practices (steel construction, pad footings, brick work, R/C slabs, beams and columns)

Reading and understanding specifications and structural drawings

Assessment scheme

Continuous assessments 30%

Final exam 70%

Module Code	**ER 4232**	Title	**MANAGEMENT ASPECTS OF GROUND WATER RESOURCES**			
Credits	**2.0**	Hours/ Week	Lectures	3	Pre-requisites	None
			Lab/Tutorials			

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Identify and analyze problems related to ground water management and contamination.
Formulate solutions for groundwater contamination issues.
Design a rainwater harvesting scheme.

Course Outline
Introduction to Hydrology
Groundwater flow and transport
Ground water pollution and contaminant transportation
Introduction to ground water modeling
Rain water harvesting and recharging
Use of RS and GIS for ground water management

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 4532**	Title	**JEWELLERY PRODUCTION MANAGEMENT**			
Credits	**3.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	3		

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Manage Jewellery production units involving hand made Jewellery, casting, electroforming, and EDM.

Course Outline
Production - Investment casting, electroforming, EDM (electrical discharge machining), die striking (stamping), Fabrication, CAM, hand crafting, organization, management of metal loss;

Quality Assurance - Laws and regulations, stamping, assaying, hallmarking, quality attributes, statistical methods, inspection methods, laboratory reports and certificates, hazardous materials

Assessment scheme
Continuous assessments 30%
Final exam 70%

Module Code	**ER 4432**	Title	**MARINE SURVEY**			
Credits	**2.5**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	1.5	**ER 3942**	

Learning Outcomes
Upon successful completion of this module, the student should be able to:
Apply beach and coastal surveying methods in the field.

Course Outline
Basic geodesy
Geodetic datum and spheroid
Map projections
Hydrography; simple bathymetric maps; software related to hydrography.
Offshore navigational positioning (GPS and DGPS).
Dassic techniques and sampling techniques.
Tides and tidal process.
Sources of error; instrument calibration and error budgets.
Beach profiling.

Assessment scheme
Continuous assessments 30%
Final exam 70%

<table>
<tr><td>Module Code</td><td>ER 4202</td><td>Title</td><td colspan="4">RESEARCH PROJECT</td></tr>
<tr><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Hours/ Week</td><td>Lectures</td><td></td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Lab/Tutorials</td><td>9</td></tr>
<tr><td colspan="7">Learning Outcomes
Upon successful completion of this module, the student should be able to:
Explain the concepts on conducting a scientific research project.
Demonstrate writing skills on research proposals and final reports.
Demonstrate the concepts on publication of research (abstract, full paper and conference presentation).</td></tr>
<tr><td colspan="7">Course Outline
Literature review/ Individual Presentation
Planning of project work/ Preparation of work program
Research proposal and group presentation
Field work (if necessary)
Laboratory testing programs (if necessary)
Analysis of data
Interpretation of data
Writing the research project report
Writing the abstract/ Full paper for publications
Individual viva
Draft research project report/ Presentation
Publications on research project/ Full Paper and Conference presentation
Final report</td></tr>
<tr><td colspan="7">Assessment scheme
Continuous assessments 100%</td></tr>
</table>

Module Code	**ER 4122**	Title	**DESIGN PROJECT**			
Credits	**3**	Hours/ Week	Lectures		Pre-requisites	
			Design office work	3		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Plan and carry out an engineering design according to the client's requirement, available resources, and other limitations

Present the design performed

Demonstrate the methodology adopted in an engineering design

Course Outline

Identification of the problem (objectives)
Carry out a rapid assessment to identify the clients requirements, available resources and possible limitations
Writing a Terms of Reference (TOR)
Carrying out an EIA
Brain storming for alternative solutions
Detail investigation for the design details
Planning and Preliminary design
Detail design
Negotiation with the stakeholder to match the objectives
Preparation of tender documents
Other work associated with implementation of the project with project management aspects

Note-
The students will be working in groups (8 – 10 per group). All the groups will be handling all the activities given above. It will be the responsibility of the students to handle the whole process under the guidance of the assigned staff member (group supervisor) and submit the project deliverables as a complete document. In addition, guest lecturers presenting related case studies etc will be organized when necessary to provide additional insight into the project deliverables.

Assessment scheme

Continuous assessments 100%

Module Code	**ER 4112**	Title	**NATURAL DISASTER PREVENTION, MITIGATION AND PREPAREDNESS**			
Credits	**2.0**	Hours/ Week	Lectures	2	Pre-requisites	None
			Lab/Tutorials	0		

Learning Outcomes

Upon successful completion of this module, the student should be able to:

Explain the basic concepts on natural hazards.
Discuss the methods in hazard and risk assessments.
Explain the concepts on disaster prevention, mitigation and preparedness.

Course Outline

Hazard and Disaster
Natural and Man-made Hazards
Geological Disasters
- Landslides
- Earthquakes and tsunami generation
- Volcanic eruptions

Meteorological Disasters
- Storm Surges
- Lightening

Hydrological Disasters
- Droughts
- Floods

Hazard/ Hazard Assessment
Risk/ Risk Assessment/ Risk Management
Sensor Systems for monitoring, forecasting and warning dissemination
Prevention, Mitigation and Preparedness

Assessment scheme

Continuous assessments 30%
Final exam 70%