Geophysical Study Plan

Geology and Geophysical Department

2013 – 1434H

King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans

Geophysical Study Plan

1st Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
CI 140	Learning, Thinking and Research Skills	-	-	3 (3+0+0)
CHS 150	Health and Fitness	-	-	1 (1+0+0)
ENG 140	English Language (1) **(E)**	-	-	8 (8+0+0)
MATH 140	Introduction to Mathematics **(E)**	-	-	2(1+1+0)
Total of Credit Hours				**14**

2nd Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
CT 140	Computer Skills **(E)**	-	-	3 (0+0+3)
MC 140	Communication Skills	-	-	2 (2+0+0)
ENG 150	English Language (2) **(E)**	ENG 140	-	8 (8+0+0)
MATH 150	Differential Calculus **(E)**	MATH 140	-	3(2+1+0)
ENT 101	Entrepreunership	-	-	1(1+0+0)
Total of Credit Hours				**17**

3rd Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. –Pract.)**
GEO 101	Physical Geology	-	-	4 (3+0+1)
PHYS 101	General Physics	-	-	4 (3+0+1)
CHEM 101	General Chemistry (1)	-	-	4 (3+0+1)
MATH 111	Integral Calculus	MATH 150	-	4 (3+1+0)
Elective course from University Requirement				2 (2+0+0)
Total units				**18**

4th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
GPH 201	Principles of Geophysics	PHYS 101, MATH 150	-	3 (2+0+1)
GEO 221	Mineralogy	GEO 101	-	3 (2+0+1)
PHYS102	General Physics (2)	-	-	4 (3+0+1)
MATH 200	Differential Calculus and Integration	MATH 111	-	3 (3+0+0)
Elective course from University Requirement				2 (2+0+0)
Total units				**15**

5th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. –Pract.)**
GPH 211	Gravity & Magnetic Exploration	GPH 201	-	3 (2+0+1)
GPH 221	Seismic Exploration	GPH 201	-	3 (2+0+1)
GEO 236	Principles of Stratigraphy & Sedimentation	GEO 221	-	3 (2+0+1)
GEO 320	Petrology	GEO 221	GEO 236	3 (2+0+1)
PHY 201	Mathematical Physics (1)	PHY 101	-	3 (2+1+0)
Elective course from University Requirement				2 (2+0+0)
Total Units				**17**

6th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
GPH 231	Geoelectric & Electromagnetic Exploration	GPH 201	-	3 (2+0+1)
GPH 381	Geophysical Reports	-	GEO 381	1 (1+0+0)
GEO 381	Structural Geology	GEO 236	-	3 (2+0+1)
PHYS 221	Electromagnetism (1)	PHYS 101	-	3 (3+0+0)
MATH 204	Differential Equations	GEO 323	-	3 (3+0+0)
Elective course				3
Total Units				**16**

Summer semester				
Course code	**Course title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
GPH 393	Field Geophysics	GPH 211, GEO320, GEO 236, GEO381	-	6 (0+0+6)
Total Units				**6**

7th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. –Pract.)**
GPH 313	Seismology	GPH 201	-	3 (2+0+1)
GPH 341	Geophysical Well Loggings	GPH 201	-	3 (2+0+1)
GPH 411	Geophysical Data Processing	GPH 211, GPH 221	-	3 (2+0+1)
GPH 496	Graduation Project (1)	GPH 393, GPH 381	-	3 (0+0+3)
Elective course				3
Total Units				**15**

8th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
GPH 390	Radiometric and Geothermal methods	GPH 201	-	2 (2+0+0)
GPH 401	Physics of the Earth	GPH 313	-	2 (2+0+0)
GPH 412	Engineering Seismology		-	2 (2+0+0)
GEO 478	Geographical information systems	GEO 381	-	2 (1+0+1)
GEO 452	Petroleum Geology	GEO381, GEO236	-	3 (2+0+1)
GPH 497	Graduation Project (2)	GPH 496	-	3 (0+0+3)
Elective course from University Requirement				2 (2+0+0
Elective course				2
Total Units				**18**

(Lect - Exer – Pract) = (Lecture – Exercise – Practical)

(E) = Courses in English

List of the Elective Courses of the University Requirements

(Student elects 8 credit hours)

Course Code	Course Title	Pre-requisite	Credits (Lect. – Exer. - Pract.)
IC 100	Studies in the Biography of the Prophet	-	2 (2+0+0)
IC 101	Introduction of Islamic Culture	-	2 (2+0+0)
IC 102	Islam and Building up the Society	-	2 (2+0+0)
IC 103	Economic System in Islam	-	2 (2+0+0)
IC 104	Political system in Islam	-	3 (2+0+1)
IC 105	Human Rights	-	3 (2+0+1)
IC 106	Islamic Jurisprudence	-	2 (2+0+0)
IC 107	Ethics of Occupation	-	2 (2+0+0)
IC 108	Contemporary Issues	-	2 (2+0+0)
IC 109	Woman and Her Developmental Role	-	2 (2+0+0)

List of the Elective Courses from inside and outside the specification

(Student elects 8 credit hours)

Course Code	Course Title	Pre-requisite	Credits (Lect - Exer- Pract)
GPH 317	Time Series Analysis	PHYS 102	2 (2+0+0)
GPH 319	Petrophysics	GEO 101 – GEO 236 - GEO 320	2 (2+0+0)
GPH 416	Seismotectonics of the Middle East	GPH 313	2 (2+0+0)
GPH 424	Environmental Geophysics	GPH 211 – GPH 221 – GPH 231	2 (2+0+0)
GEO 323	Igneous and Metamorphic Petrology	GEO 221	3 (2+0+1)
GEO 334	Sedimentary Petrology	GEO 236	3 (2+0+1)
GEO 383	Remote Sensing		3 (2+0+1)
GEO 386	Geology of the Arabian Shield	GEO 323	3 (2+0+1)
GEO 482	Geology of The Kingdom	GEO 334	3 (2+0+1)
GEO 455	Hydrology	GEO 236 – GEO 381	3 (2+0+1)
PHYS 231	Vibrations and Waves	PHYS 101	3 (2+1+0)
MATH 244	Linear Algebra	-	3 (3+0+0)
STAT 100	Introduction to Statistics	MATH 150	3 (2+1+0)
BUS 101	Principles of Business Administration	-	3 (3+0+0)
ECON 101	Principles of Microeconomics	-	3 (3+0+0)

List of service courses to other Specialization.

Course Code	Course Title	Credits (Lect. – Exer. - Pract.)	Pre-Req.	Spec. /College of
GPH 201	Principals of Geophysics	3 (2+0+1)	-	GEO
GPH 301	Geophysical Exploration	3 (2+0+1)	-	GEO

Short Courses Description

I- Compulsory courses *from* the Specialization

Course title: Principles of Geophysics	**Course number and code: GPH 201**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Physical and mathematical laws and its relation to the Earth's properties. Elasticity theory and properties of wave propagation in seismic reflections, refractions, wave equations, seismic wave characteristics, and potential field theories. Principles of different exploration techniques. Interpretation of the Earth's structures by geophysical data.	

Course title: Gravity and Magnetic Exploration	**Course number and code: GPH 211**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Introduction, Importance and use of gravity and magnetic exploration methods. Instruments for gravity and magnetic measurements. Gravity and magnetic surveying. Data acquisition, reduction, and processing. Application of gravity and magnetic methods to oil, mineral and groundwater exploration. Interpretation of Aeromagnetic maps. Qualitative and quantitative interpretation of gravity and magnetic data. (Field Trip – Two Days).	

Course title: Seismic Exploration	**Course number and code: GPH 221**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Introduction, Importance of seismic exploration. Seismic waves and factors affecting its propagation. Seismic velocities. Reflection and refraction. Time-distance relations for reflected and refracted seismic waves in layered media. Instrumentations and field procedures. Seismic sources. Corrections of seismic data, Seismic noise. Multiple seismic reflections. Measurements of seismic velocities. Data reduction and qualitative and quantitative interpretation. Seismic migration. Seismic Stratigraphy. (Field Trip – Two days).	

Course title: Geoelectric and Electromagnetic Exploration	**Course number and code: GPH 231**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Introduction and importance of the electrical and electromagnetic methods and their applications. Electrical conductivity of rocks. Basic theory of direct current conduction and EM induction. Time domain and frequency domain systems. Transient EM. Induced and spontaneous polarization. Down-hole electric and EM techniques. Instrumentations. Field procedures. Qualitative and quantitative interpretation. (Field work – Two days).	

Course title: Earthquake Seismology	**Course number and code: GPH 313**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Causes and types of Earthquakes. Historical background. Earthquake measuring instruments. Seismic wave propagation in spherical Earth and travel time graphs. Earthquakes source parameters and scale of magnitudes/intensity. Processing of Earthquakes data. Earthquakes mechanisms. International	

observatory networks. Internal structure of the Earth. Solutions of Earthquake focal mechanism. Heterogeneity and inelasticity.

Course title: Geophysical Well Logging	**Course number and code: GPH 341**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Uses of geophysical well logging. Different types of geophysical logging, i.e., the resistivity logging, self-potential logging, natural and induced radioactivity logging, density logging and seismic logging. Interpretation of these geophysical logs. (Field work - Two days).	

Course title: Geophysical Reports	**Course number and code: GPH 381**
Effective hours: 1 (1+0+0) (Lect. – Exer. – Lab.)	
Writing scientific papers, Theses and reports. Methods of criticism. Geophysical terminologies. Geophysical data presentation. Structure of a geophysical report. How to write an ideal technical report and scientific paper. Manifestation of results.	

Course title: Radiometric and Geothermal Methods	**Course number and code: GPH 390**
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
Rocks radiation. Theory of radioactivity and half life. Instruments for measuring natural radiation. Radiometric survey on land and from air. Interpretation of radiometric data. Temperature of the Earth and its relation to radioactive materials. Theory of heat flow. Temperature gradient with depth and its variation with time and location. Geothermal measurements. Application of radiometric and geothermal methods to modern day problems.	

Course title: Field Geophysics	**Course number and code: GPH 393**
Effective hours: 6 (0+0+6) (Lect. – Exer. – Lab.)	
Field study in a summer camp for forty five days. Introduction to different geological techniques for topographic and geologic mapping. Developing subsurface geologic maps for selected areas under study. Basic geological relationships with emphasis on structural and stratigraphic correlation for different types of rocks. Geophysical field measurements, data processing, reduction, and interpretation. Completion of weekly reports and final project report as a team.	

Course title: Physics of the Earth	**Course number and code: GPH 401**
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
Structure of the Earth deduced from geophysical methods: the crust, mantle and core, their physical and Chemical properties. Terrestrial heat flow, convection currents and phase transitions. Geomagnetism of rock magnetism and paleomagnetism. Relation between seismology, global gravity, densities, earth's magnetism and the structure of the Earth. Plate tectonics. Hydrostatic sphere. Free oscillations of the Earth. Principles of isostasy.	

Course title: Geophysical Data Processing	**Course number and code: GPH 411**
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Theory of frequency filtering. Separation techniques for regional and residual fields in space and frequency domain. Methods to calculate the second vertical derivatives for potential fields. Downward and upward modeling of magnetic data. Ambiguities in the interpretation of potential field data. Linear analysis, theory of digital data. Fast forward and inverse Fourier analysis and its application in data processing. Advanced seismic data interpretation. Seismic stratigraphy and direct detection of hydrocarbons.	

Course title: : Engineering Seismology	Course number and code: GPH 412
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
Probabilistic and deterministic theory. Different kinds of earthquake sources and its relation to faulting mechanism. Seismic risk and hazard, Seismic zoning. Attenuation relations, soil liquefaction. Earthquake response from structures. Designing of earthquake - resistant structures.	

Course title: Graduation Project (1)	Course number and code: GPH 496
Effective hours: 3 (0+0+3) (Lect. – Exer. – Lab.)	
Senior student's engagement in individual/independent research project with faculty supervision. Investigation of any selected problems in applied or theoretical geophysics. Determine the subject of research and development of systematic planning to conduct research - a review and study of previous studies - studies and field data collection and measurement.	

Course title: Graduation Project (2)	Course number and code: GPH 497
Effective hours: 3 (0+0+3) (Lect. – Exer. – Lab.)	
Analysis and discussion of data - data processing - interpretation of results - a written report must be submitted and oral presentation made for evaluation by a committee appointed by the department.	

II- Compulsory courses *from OUTSIDE* the Specialization:

Course title: Physical Geology	Course number and code: GEO 101
Effective hours: 4 (3+0+1) (Lect. – Exer. – Lab.)	
Introduction to physical geology and minerals – volcanism and intrusive igneous rocks – weathering, soil, sediments and sedimentary rocks – metamorphism and metamorphic rocks – water courses and groundwater – glaciers and glaciations – deserts and coasts – geological structures – earthquakes – plate tectonics – mountain belts and continental growth – earth resources.	

Course title: Mineralogy	Course number and code: GEO 221
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Crystallization in solutions and magma – crystal symmetry – crystal forms and habits – crystallographic systems – crystal lattices – chemical and physical properties of minerals – classification and nomenclature of minerals – origin and distribution of minerals - physics of light and its interaction with crystalline matter – the polarizing microscope – thin section preparation – refraction indices – optical indicatrix – optical sign determination – mineral identification – qualitative and quantitative analysis of minerals.	

Course title: Principles of Stratigraphy & Sedimentation	Course number and code: GEO 236
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Erosion, transport and sedimentation – grain morphology – porosity, permeability and diagenesis – classification of sedimentary rocks – sedimentary structures – stratigraphic units and correlation – seismic stratigraphy – sequence Stratigraphy – use and interpretation of stratigraphic maps and sections.	

Course title: Petrology	Course number and code: GEO 320
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Extrusive and intrusive igneous rocks – classification and field relations of igneous rocks - weathering – clastic sedimentary rocks – carbonates and evaporites – metamorphism and metamorphic rocks – metamorphic zones and facies – a brief summary on the Arabian Shield and the sedimentary cover in Saudi Arabia.	

Course title: Structural Geology	Course number and code: GEO 381
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Stress, strain and rock deformation - kinematic analysis – interpretation of geologic maps – stereographic projections - joints – strike-slip faults – dip-slip faults – geometry of folds – foliation and lineation – balanced cross-sections - rheology – microscopic structures – orogenic belts and plate tectonics.	

Course title: Petroleum Geology	Course number and code: GEO 452
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Physical properties of oil, gas and connate water – porosity and permeability and the effect of diagenesis – origin, migration and accumulation of oil – oil traps and seals – drilling methods - oil exploration – formation evaluation – chemistry and grades of crude oil – reserve estimation - oil in Saudi Arabia.	

Course title: Geographical information system	Course number and code: GEO 478
Effective hours: 2 (1+0+1) (Lect. – Exer. – Lab.)	
The concept of GIS – maps and spatial analysis – data entry, storage and retrieval – computer-based processing of geologic data – vector and raster data models and analysis – linking digital maps and attribute information - spatial interpolation - practical application through a real-life GIS project.	

Course title: General Chemistry (1)	Course number and code: CHEM 101
Effective hours: 4 (3+0+1) (Lect. – Exer. – Lab.)	
Theoretical Part: **Stoichiometry**: SI units, chemical formulas, the mole, methods of expressing concentration, calculations based on chemical equations. **Gases**: Laws, kinetic theory, deviation and van der Waals equation. **Thermo chemistry**: Types of enthalpy changes, Hess Law and its applications,, first law of thermodynamics. **Solutions**: Type of solutions and laws related, colligative properties. **Chemical Kinetics**: Law of reaction rate, reaction order, factors affecting the reaction. *Chemical* **Equilibrium**: Reaction between K_c & K_p, Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions. **Practical Part:** Eleven experiments including: Physical properties of mater, Hess's law, chemical kinetics, volumetric analysis.	

Course title: General Physics (1)	Course number and code: PHYS 101
Effective hours: 4 (3+0+1) (Lect. – Exer. – Lab.)	
The concept of GIS – maps and spatial analysis – data entry, storage and retrieval – computer-based processing of geologic data – vector and raster data models and analysis – linking digital maps and attribute information - spatial interpolation - practical application through a real-life GIS project.	

Course title: General Physics (2)	Course number and code: PHYS 102
Effective hours: 4 (3+0+1) (Lect. – Exer. – Lab.)	
Vectors, Motion in straight line, Newton's Laws of motion, work, energy and momentum, simple harmonic motion, elasticity, mechanics of non-viscous fluids, flow of viscous fluids, surface tension, temperature, quantity of heat, work and heat.	

Course title: Mathematical Physics (1)	Course number and code: PHYS 201
Effective hours: 3 (2+1+0) (Lect. – Exer. – Lab.)	
- System of Linear Equations: Methods of solving Systems of Linear equations (Elimination methods, Gauss- Jordan …). - Matrices: (Definitions, Operations on Matrices, Transpose Matrix, the trace…). The inverse, Elementary row operation method, the determinant, Cramer's rule. - Vector spaces: Two and Three dimensional vector spaces, Distance in two and Three dimensional spaces. Norms, Dot product, projection, cross product, N-dimensional (linear) spaces: Euclidean spaces, Inner product spaces, Linear Transformations, Eigen values and Eigenvectors problems.	

Course title: Electromagnetism	Course number and code: PHYS 221
Effective hours: 3 (3+0+0) (Lect. – Exer. – Lab.)	
Electrostatics, Gauss Law and its application, Capacitors, the magnetic field of conductors with different shapes, Ampere's law and its applications. Induced electromotive force, Faraday's law. Lenz's law, magnetic properties of matter, analysis of AC circuits, resonance in series and parallel circuits	

Course title: Integral Calculus	Course number and code: MATH 111
Effective hours: 4 (3+1+0) (Lect. – Exer. – Lab.)	
Definition of definite integral and its properties, the anti-derivative, indefinite integral and the fundamental theorem of calculus. Change of variables. Integrals of natural and general exponential functions. Integrals of natural and general logarithmic functions. Derivatives and integrals of hyperbolic and inverse-hyperbolic functions. Techniques of integration: by parts, trigonometric substitutions, completing the square, integrals of rational functions, miscellaneous substitutions. Indeterminate forms, improper Integrals. Applications of integration: area, solids of revolution, arc length and surface of revolution, linear Motion, work, momentum and center of mass. Numerical integration. Polar coordinates, relation between polar and Cartesian coordinates, graphs of polar curves, area in polar coordinates. Parametric equations.	

Course title: Differential and Integral Calculus	Course number and code: MATH 200
Effective hours: 3 (3+0+0) (Lect. – Exer. – Lab.)	
Cartesian, cylindrical and spherical coordinate systems. Functions of two and three variables, limits and continuity, partial derivatives, the chain rule, extrema of functions of two variables, Lagrange multipliers. Double integrals, moments and center of mass, double integrals in polar coordinates, triple integrals, applications of triple integrals, triple integrals in cylindrical and spherical coordinates, surface area. Sequences, infinite series, convergence tests, representation of functions by power series, Taylor and Maclaurin series, the binomial series.	

Course title: Differential Equations	Course number and code: MATH 204
Effective hours: 3 (3+0+0) (Lect. – Exer. – Lab.)	
Classification of Differential equations and their origins. Methods of solution of first order differential equations, orthogonal trajectories. Linear equations with constant coefficients and variable coefficients. Linear systems of equations, power series solutions of linear differential equation of the second order with polynomial coefficients, Laplace transform and the convolution. Fourier's series.	

III- Elective courses *from* the Specialization:

Course title: Time Series Analysis	Course number and code: GPH 317
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
Different types of Fourier series analysis. Digital filtering. Matrix processing techniques. Waves polarity analysis. Application of inverse linear and non-linear theories in solving geophysical problems.	

Course title: Petrophysics	Course number and code: GPH 319
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
A review of sedimentary, igneous and metamorphic rocks. Physical properties of rocks that affect the distribution and movement of fluids (such as oil, gas, water and contaminants) in porous media including porosity, permeability, capillary pressure, surface and interfacial tension, wet-ability, and viscosity. Darcy's law for anisotropic porous media.	

Course title: Seismotectonics of the Middle East	Course number and code: GPH 416
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
A comprehensive study about tectonics of the Middle East. Arabian plate boundaries. Correlation between the earthquake occurrences and tectonically active regions. Red Sea spreading and Dead Sea transform fault system. Tectonic activities in Atlas mountains, Afar triangle, and Arabian Gulf. Crustal Structure of the Arabian Plate.	

Course title: Environmental Geophysics	Course number and code: GPH 424
Effective hours: 2 (2+0+0) (Lect. – Exer. – Lab.)	
The use of all geophysical methods (Seismic, gravity, Magnetic, Ground Penetrating Radar, Electrical, and Radiometric) in solving environmental problems. Pollution determination and monitoring. Site selection for waste disposal. Geophysical impact assessment of engineering structures to ensure its safety and suitability for environment protection.	

IV-Elective courses *from OUTSIDE* the Specialization:

Course title: Igneous and metamorphic petrology	Course number and code: GEO 323
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Origin and composition of magma – magmatic differentiation – volcanism and its products – emplacement mechanisms of plutonic rocks – geochemistry of igneous rocks and its relationship with their tectonic settings – types of metamorphism- field relations – metamorphic textures – metamorphic zones – metamorphic reactions and P-T-t paths.	

Course title: Sedimentary petrology	Course number and code: GEO 334
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Grain morphologies and statistical distribution of grain size – classification of sedimentary rocks - mineral composition of detrital rocks and its relationship to the tectonic setting – diagenesis – carbonate rocks and evaporites – phosphorites – ironstones – siliceous rocks – coal and coalification processes.	

Course title: Remote Sensing	Course number and code: GEO 383
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Basics of remote sensing – electromagnetic spectrum –types of sensors and platforms – acquiring and processing primary data – spatial corrections – types of filters - image enhancement - interpretation – classification methods – principal component analysis – thermal and radar imaging - geologic applications.	

Course title: Geology of Arabian Shield	Course number and code: GEO 386
Effective hours: 2 (1+0+1) (Lect. – Exer. – Lab.)	
Origin of the Arabian Shield – stratigraphic schemes – igneous and tectonic activity – island arc and microcontinents - allochthonous terranes – ophiolites and sutures – correlation with the Nubian Shield – the Pan-African episode – Archean terranes in the Arabian Shield – ore deposits in the Arabian Shield.	

Course title: Sedimentary Geology of the Kingdom	Course number and code: GEO 482
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Sedimentary basins of Saudi Arabia – Phanerozoic stratigraphic units – sedimentary cycles – intra-basin stratigraphic correlations – biostratigraphy – major structural trends – economic geology of the cover rocks.	

Course title: Hydrology	Course number and code: GEO 455
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Geologic factors controlling the flow of groundwater – porosity and permeability – groundwater flow - types of aquifers – Darcy's law – groundwater wells – chemistry of groundwater – groundwater exploration – seawater encroachment – groundwater pollution - groundwater resources in Saudi Arabia.	

Course title: Vibrations and Waves	Course number and code: PHYS 231
Effective hours: 3 (2+1+0) (Lect. – Exer. – Lab.)	
Periodic motions, the super position of periodic motion, free vibrations, Damped Vibrations, Forced Vibrations, Forced vibrations in strings, longitudinal motion in bars, Fourier analysis.	

Course title: Linear Algebra	Course number and code: MATH 244
Effective hours: 3 (3+0+0) (Lect. – Exer. – Lab.)	
Matrices, Determinants, and its use in solving systems of linear equations - Vector spaces and subspaces Inner product spaces - Linear transformations - Eigen values and eigen vectors	

BUS 101	Principles of Business Administration	3 (3+0+0)
ECON 101	Principles of Microeconomics	3 (3+0+0)

V- Service Courses to Other Specialization:

Course title: Principles of Geophysics	Course number and code: GPH 201
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Physical and mathematical laws and its relation to the Earth's properties. Elasticity theory and properties of wave propagation in seismic reflections, refractions, wave equations, seismic wave characteristics, and potential field theories. Principles of different exploration techniques. Interpretation of the Earth's structures by Geophysical data.	

Course title: Geophysical Exploration	Course number and code: GPH 301
Effective hours: 3 (2+0+1) (Lect. – Exer. – Lab.)	
Magnetic and gravity exploration; Geoelectrical Methods; Electrical resistivity, Self-Potential and Induced Polarization; electromagnetic Methods; Seismic methods; Seismic Reflection and refraction methods; seismology; Ground Penetrating Radar, Radioactive and thermal methods. Application of these methods for natural resources exploration. Qualitative and quantitative interpretation of the Geophysical data. (Field work - Two days).	

Important Note: The student must review the department concerned for decisions that taught outside the college (Compulsory and Elective).