1. Applied Geoinformatics

1.1. Brief about the Program

- **Program Host** : Yarmouk University
- **Study Plan** : M.Sc. Degree
- **Plan Type** : Thesis\Non-Thesis
- **Academic Year** : 2019
- **Number of Credit Hours :** 33 Credit Hours

1.2. Motiovation of the Program

The idea of developing the program came as a result of reviewing the actual situation of the outputs of the Jordanian universities and institutes and the need of the local and regional labor market in relation to the spatial information and its management systems and their practical applications. Survey results showed :1) Students need to update their skills and knowledge in geospatial information by developing modern academic programs that focus on new technologies and equipped with new labs; 2) urgent need to supply the labor market with skilled professionals who have the scientific knowledge and practical skills necessary to advance the development process in Jordan.

Applied Geoinformatics program at Yarmouk University is the first of its kind in Jordan and one of the few programs in the Arab region. It focuses on topics such as geospatial data collection, training, graduation project, space, large data, Web-GIS and databases. It will be one of the main pillars aiming at achieving the priorities of scientific research in Jordan, namely the employment of GIS and remote sensing techniques and their applications in sustainable development and national economic stimulus programs.

1.3. Competences and learning outcomes

- Discuss the theoretical principles of Geo-informatics and their role in modeling and solving environmental and urban and social issues.
- Recognize advanced analysis and interpretation skills needed in Geo-informatics.
- Apply practical remote sensing and GIS procedures for assessing and solving environmental, urban, geologic and societal problems.
- Communicate Geo-informatics related ideas and results both orally and in writing.
- Develop Geo-informatics project management, team work and leadership skills.
- Produce scientific research related to the applications of Geo-informatics.
- Ability to engage in life-long learning
- Understanding of professional and ethical responsibilities
- Ability to analyze a multi-dimensional data set for natural resources management

1.4. Employment/career opportunities

Graduates from this program will have great chance to find job opportunities in the following governmental agencies and private sectors:

- Ministry of Energy and Mineral Resources
- National Petroleum Company
- The Ministry of Environment
- The Ministry of Public Works and Housing
- Ministry of Municipal and Rural Affairs
- Ministry of Agriculture
- Royal Jordanian Geographical Center
- Royal Scientific Society
- The Ministry of Planning and International Cooperation
- Jordanian Armed Forces
- Ministry of Water and Irrigation
- Ministry of Transport and Communications Sector
- Department of Statistics
- Phosphate Company
- Universities and scientific institutes
- The Ministry of Tourism and Antiquities
- Ministry of Tourism
- National Electricity Company
- Private sector (engineering and mining companies, space companies, consulting firms, etc)

1.5. Curriculum

I) Thesis Track

a) Compulsory courses: (15) Fifteen credit hours as follow:

Course Name	Weekly Hours		Credit Hours	Prerequisites
	Theoretical	Practical		
Geospatial Data Acquisition	2	1	3	-
Geodatabase Management	2	3	3	-
Geospatial Data Analysis	2	1	3	Geospatial Data Acquisition
Remote Sensing and Photogrammetry	2	1	3	-
Research Methods in Geoinformatics	3	0	3	-

b) Elective courses: (9) Nine credit hours selected from the following list**:**

Course Name	Weekly Hours		Credit Hours	Prerequisites
	Theoretical	Practical		
Big and geocrowd-sourced data	2	3	3	-
Geo-visualization	2	3	3	-
Urban and Environmental Applications of Geoinformatics	2	3	3	Geospatial Data Analysis Remote Sensing, Photogrammetry
Geo-application Development	2	3	3	
Web GIS and Geo-services	2	3	3	Geospatial Data Analysis
Engineering Surveying	2	3	3	-
Special Topics in Geo-informatics	2	3	3	Department Approval
Environmental Systems	3	0	3	-
Advanced Environmental Geology	3	0	3	-
Earthquakes	3	0	3	-

- Students select a course from each of the following groups:

Group 1	Group 2	Group 3
• Big and geocrowd-sourced data • Geo-visualization • Special Topics in Geo-informatics	• Urban and Environmental Applications of Geoinformatics • Geo-application Development • Web GIS and Geo-services • Engineering Surveying	• Environmental Systems • Advanced Environmental Geology • Earthquakes

c) Thesis: Nine (9) credit hours.

II) Non-Thesis Track

a) Compulsory courses: (24) Fifteen credit hours as follow:

Course Name	Weekly Hours		Credit Hours	Prerequisites
	Theoretical	Practical		
Geospatial Data Acquisition	2	3	3	-
Geodatabase Management	2	3	3	-
Big and geocrowd-sourced data	2	3	3	
Geospatial Data Analysis	2	3	3	Geospatial Data Acquisition
Geo-visualization	2	3	3	-
Remote Sensing and Photogrammetry	2	3	3	-
Urban and Environmental Applications of Geoinformatics	2	3	3	Geospatial Data Analysis Remote Sensing, Photogrammetry
Research Methods in Geoinformatics	3	0	3	-

b) Elective courses: (9) Nine credit hours selected from the following list:

Course Name	Weekly Hours		Credit Hours	Prerequisites
	Theoretical	Practical		
Geo-application Development	2	3	3	Geospatial Data Analysis
Web GIS and Geo-services	2	3	3	Geospatial Data Analysis
Engineering Surveying	2	3	3	-
Special Topics in Geo-informatics	2	3	3	Department Approval
Environmental Systems	3	0	3	-
Advanced Environmental Geology	3	0	3	-
Earthquakes	3	0	3	-

- Students select two (2) courses from group1 and one course (1) from group2:

Group 1	Group 2
• Geo-application Development • Web GIS and Geo-services • Engineering Surveying • Special Topics in Geo-informatics	• Environmental Systems • Advanced Environmental Geology • Earthquakes

c) Comprehsive Exam: Zera (0) credit hours.

1.6. Sylabus for all courses related to geodesy

Course Name	Geospatial Data Acquisition
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description	This course focuses on the methods of acquiring, retrieving, storing, and exploring geospatial data from various resources including ground-, aerial-, and space-based techniques. Students will confront realistic problem scenarios that incorporate skills and concepts such as definition of data needs, metadata content standards, legal and ethical issues related to data use, data formats and types, interoperability, field collection methods and contributing data for public use. The main theoretical concepts of data acquisition and integration will be provided through course notes and assigned readings. Hands-on practical exercises and assignments will give students an opportunity to internalize and apply the concepts and theory learned throughout the course.
Learning Outcomes	After completing this course, students will be able to: • identify and evaluate appropriate and cost-effective data sources for specific applications. • design and implement a strategy for capturing or sourcing geospatial data. • critically evaluate the potential impacts of data quality on spatial analysis and decision making.
Syllabus (List of lessons)	• Defining, assessing, and evaluating data needs • Data Quality (data standards, types and sources of error) • Locate, acquire and extract data • Work with data formats • Integrate acquired data • Produce and understand metadata Field project
Prerequisite	-None
Course Literature	• Casagrande, G., Sik, A.S. & Szabó, G., 2017. **Small Flying Drones : Applications for Geographic Observation**, Cham: Springer. 161 pages. ISBN-13: 978-3319665764 • Konecny, G., 2014. **Geoinformation : remote sensing, photogrammetry, and geographic information systems**. 280 pages. ISBN-13: 978-0415237956 • Bossler, J.D., Campbell, J.B., McMaster, R.B. and Rizos, C., 2010. **Manual of geospatial science and technology**. 648 pages. CRC Press. ISBN: 9781420087345. • Chen, Y-Q, Lee, Y-C. (eds). 2001. **Geographical Data Acquisition**. Springer 1st ed, 265 pages. ISBN-10: 3211834729, ISBN-13: 978-3211834725

Course Name	Geodatabase Management
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description:	This course provides an advanced background on Database Management System (DBMS) as an integral and essential part of GIS. The course presents data models, implementation and the relational, hierarchical, and network approaches to database management systems. The course covers several aspects such as geodatabase overview, architecture, design, and building.
Learning Outcomes:	After completing this course, students will be able to: • recognize the importance of using databases in GIS environment. • develop database models for different data types. • demonstrate understanding and competency of spatial database systems such as architectures and query.
Syllabus (List of lessons)	• Introduction to spatial database. • Spatial data models • Spatial data mining • Introduction to Geodatabase. Differences between personal, file, and enterprise Geodatabase. Storing different types of data in the Geodatabase. Subtypes and topology in the Geodatabase. • Geodatabase design. • Understanding ArcSD • Working with vectors inside the GDB • Working with rasters inside the GDB
Prerequisite	-None
Course literature	• Nasser, H. 2014. **Learning ArcGIS Geodatabase**. 1st ed, 158 pages. **.** Packet Publishing. Print ISBN: 1783988649 • Zeiler, M. 2010. **Modeling Our World: The Esri Guide to Geodatabase Concepts.** 2nd ed, 308 pages. ESRI Press. Print ISBN: 1589482786. Electronic ISBN: 978-1589482784 • Arctur, David and Zeiler, M. 2004. **Designing Geodatabases: Case Studies in GIS Data Modeling**. 1st ed, 393 pages. ESRI Press. Print ISBN: 158948021X. Electronic ISBN: 978-1589480216. • Yeung, A.,Brent Hall, G. 2007. **Spatial Database Systems: Design, Implementation and Project Management (GeoJournal Library).** Springer; 2007 edition, 553 pages.. ISBN-10: 9781402053917, ISBN-13: 978-1402053917.

Course name	Big and geocrowd-sourced data
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description	This course aims to familiarize students with big data as basis for addressing substantive research questions. The focus is given to the new emerging available big data coming from different in-situ geolocated sensors, different platforms such as UAV and satellites, or those obtained as products of the processing of global high-resolution data. Emphasis will also be given to crowdsourced (for instance from social media) and voluntarily contributed data (Volunteered Geographic Information). Strengths and limitations of big geodata research are discussed in depth using real-world examples and practical exercises.
Learning Outcomes	After completing this course, students will be able to: • realize theoretical concepts of big geodata. • deal with big geodata and its analysis. • gain the required skills to deal with big geodata that raly on citizins as a source of data.
Syllabus (List of lessons)	• Introduction – What is Big GeoData? • Methodological Challenges • Sources of Big GeoData (sensors and web sensor services, imagery and high resolution imagery, global geospatial high resolution databases, social media) • Mining data • Python for Data Analysis • Case studies, examples and applications • Citizen Science • Crowd-sourced geodata: passive and active (VGI) • The OpenStreetMap database and platform • Mobile Apps for crowdsourcing geodata • Applications of crowd-sourced geodata • Collaborative platforms • Data visualisation
Prerequisite	-None
Course literature	• Li, G., Wang, J., Zheng, Y., Fan, J., Franklin, M.J. 2018. **Crowdsourced Data Management.** Springer, 159 pages. eBook ISBN 978-981-10-7847-7. • Bordogna, G. and Carrara, P., 2018. **Mobile information systems leveraging volunteered geographic information for earth observation.** 1st ed, 214 pages. Springer. Print ISBN: 978-3319708775 • Foody, G, See, L, Fritz, S, Mooney, P, Olteanu-Raimond, A-M, Fonte, C C and Antoniou, V. (eds.). 2017. **Mapping and the Citizen Sensor**. 1st ed, 400 pages. Ubiquity Press. Print ISBN: 978-1-911529-16-3. Electronic ISBN: 978-1-911529-17-0 • Capineri, C; Haklay, M; Huang, H; Antoniou, V; Kettunen, J; Ostermann, F; Purves, R (eds.). 2016. **European Handbook of Crowdsourced Geographic Information**. 1st ed, 477 pages. Ubiquity Press. Print ISBN: 978-1-909188-79-2. Electronic ISBN: 978-1-909188-80-8. • Sui, D; Elwood, D.Goodchild, M. 2013. **Crowdsourcing Geographic Knowledge: Volunteered Geographic Information (VGI) in Theory and Practice**. 1st ed, 396 pages. Springer. Print ISBN: 9400745869. Electronic ISBN: 978-9400745865.

Course name	**Geospatial Data Analysis**
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description	This course focuses on implementation of spatio-temporal analyses and spatial statistics including exploratory analysis, spatial autocorrelation and spatial regression, point and areal pattern analysis, interpolation and sampling methods, model building, distance and directional analysis, geometrical processing, map algebra, surface analysis, network and locational analysis.
Learning Outcomes	After completing this course, students will be able to: • identify the proper quantitative and geostatistical methods for solving real-world problems. • apply several geo-analytical techniques for solving real-world problems.
Syllabus (List of lessons)	• Exploratory Spatial and Spatio-temporal Data Analysis and Data Visualisation • Spatial Statistics including Spatial Autocorrelation and Spatial Regression • Spatial statistics I Point Pattern Analysis (Geometric Measurements, Quadrat Count Analysis, Kernel Density Analysis, Nearest Neighbor Analysis) • Spatial statistics II. Line Data Analysis (Line Length, Line Density, Line Direction, Line Orientation) • Network Analysis (Routing, Service Area, Closest Facilities, O-D Cost Matrix) • Areal Analysis (Spatial Autocorrelation, Joint Count) • Surface Analysis I (Spatial Interpolation, Distance Analysis, Density Analysis, Surface Analysis Operations). • Surface Analysis II • 3-D Analysis (Draping, Extrusion, Line-of-Sight, Viewshed, Skylines, Volumetric Analysis, Animation).
Prerequisite	Geospatial Data Acquisition
Course literature	• Thill, J.-C., Dragicevic, S. (eds) 2018. **GeoComputational Analysis and Modeling of Regional Systems.** 1st ed, 410 pages. Springer International Publishing. Print ISBN: 978-3319595092 • Lombard et al., 2016. **Applied spatial modelling and planning.** 1st ed, 386 pages. Routledge - Taylor & Francis Group. Print ISBN: 978-1138925700 • Mitchel, A. **The Esri Guide to GIS Analysis** (three volumes). Esri Press: ○ **Geographic Patterns and Relationships**. 1999. Volume 1, 1st ed, 186 pages. ESRI Press. Print ISBN: 1879102064. Electronic ISBN: 978-1879102064. ○ **Spatial Measurments and Statistics.** 2005.Volume 2, 1st ed, 252 pages. ESRI Press. Print ISBN: 158948116X. Electronic ISBN: 978-158116X ○ **Modeling Suitability, Movement, and Interaction**. 2012. Volume 3, 1st ed, 420 pages. Esri Press. Print ISBN: 978-1589483057.

Course Name	Geo-visualization
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description:	This course provides students with both the conceptual understanding and practical experience needed to design effective dynamic geographic representations. The course explores issues of computer based mapping and Geo-visualization including concepts for geographic data representation, symbolization, map design, 3D visualization, and web-based mapping.
Learning Outcomes:	After completing this course, students will be able to: • implement advanced geo-visualization tools using industry standard software. • produce outstanding visual representation of geographic data using current geo-visualization tools • demonstrate understanding on how interactive and dynamic maps are made.
Syllabus (List of lessons)	• Intro to geovisual analytics, Atlas topic and structure, Mapping techniques and design overview. • Visual variables and color, vector data model, Choropleth mapping. • Map projections and coordinate systems • Typography and label placement. Raster data model. Terrain mapping. • Layout, mapping critique. • Flow maps. Network analysis • Online-mapping with OnlineGIS. • 3D thematic maps with ArcPro • Geo-visualization LiDAR data in ArcPro
Prerequisite	-None
Course literature	• Gorr, W and Kurland, K. 2017. **GIS Tutorial 1 for ArcGIS Pro: A Platform Workbook.** 1st ed, 482 pages. ESRI Press. Print ISBN: 1589484665. Electronic ISBN: 978-1589484665. • Crampton, J. 2010. **Mapping: A Critical Introduction to Cartography and GIS**. Wiley-Blackwell; 1 edition, 232 pages. ISBN-13: 978-1405121736, ISBN-10: 1405121734. • Slocum T., McMaster R.B., Kessler F.C., Howard H. 2008. **Thematic Cartography and Geovisualization**. 3rd ed, 576 pages. Pearson. Print ISBN: 0132298341. • Dykes, J., MacEachren A., Kraak, M.2005**. Exploring Geovisualization.** Pergamon, 1st Edition, 730 pages. eBook ISBN: 9780080531472, ISBN: 9780080445311. • Brewer C. 2005. **Designing Better Maps: A Guide for GIS Users**. 1st ed, 220 pages. ESRI Press. Print ISBN: 1589480899.

Course Name	Remote Sensing and Photogrammetry
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description	The focus is given to satellite remote sensing, airborne, drone and terrestrial photogrammetry; and airborne, terrestrial and mobile laser scanning. Optical, multispectral, hyperspectral and microwave sensors are presented. The state-of-the-art sensor technology is presented and discussed. Advanced techniques for image quality enhancement, data fusion, classification and change detection based on images and point clouds are illustrated. The data acquisition workflow using modern surveying techniques such as unmanned aerial vehicle (UAV) and laser scanner is analysed.
Learning Outcomes:	After completing this course, students will be able to: • work with various remote sensing data types and spectrum. • deal with advanced methods of remote sensing-based image processing techniques. • prepare a workplan to deal with various advanced serveying devices including drones and 3D laser scanners.
Syllabus (List of lessons)	• Introduction: overview on technologies for Earth Observation. • Physical aspects of the electromagnetic spectrum. • Interaction between electromagnetic waves and the atmospheric and Earth surface • Examples of spectra from different types of materials. • Remote sensor technology: parameters, spatial and radiometric resolution, classification of sensors, and radiometric calibration. • Image formation: digital image structure, sampling theory and quantization. processes, aliasing, colour spaces. • Geometric correction of satellite images. • Radiometric calibration: background, lab experiments. • Thematic classification: concepts of thematic mapping, classification criteria, supervised and unsupervised techniques, pixel-based and object-based methods, multi criteria methods, validation. • Extraction of biophysical and geophysical parameters from images.
Prerequisite	-None
Course literature	• Shan, Jie, and Charles K. Toth. 2018. **Topographic laser ranging and scanning: principles and processing**. 2nd ed, 655 pages. CRC press. Print ISBN: 9781498772273. Electronic ISBN: 9781315154381. • Dong, P, and Qi Chen. 2018. **LiDAR Remote Sensing and Applications**. 1st ed, 220 pages. CRC Press, Taylor & Francis Group. Print ISBN: 1482243016. Electronic ISBN: 9781482243017. • Pu, Ruiliang. 2017. **Hyperspectral Remote Sensing: Fundamentals and Practices**. 1st ed, 466 pages. CRC Press. Print: ISBN 978-1-118-34328-9. • Linder, W. 2016. Digital photogrammetry: A Practical Course. Springer-Verlag Berlin Heidelberg. 4th ed. Print ISBN: 978-3-662-504628. Electronic ISBN: 978-3-662-504635. • Lillesand, T., Kiefer, R., and Chipman, J. 2015. **Remote sensing and image interpretation**. John Wiley & Sons. 7th ed. 736 pages. Print: ISBN 978-1-118-34328-9. Electronic ISBN: 978-1-118-34328-9.

Course Name	Urban and Environmental Applications of Geoinformatics
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description	This course will give students a fundamental understanding of how geoinformatics is currently used in urban and environmental sciences. The course focuses on the application of geoinformatics by integrating theory and application of spatial analysis to solving real-world urban and environmental problems in specific topics such as: air pollution, climate change, biodiversity, soil management, natural hazards, water resources, vegetation and forestry, land use and land cover, urban landscapes, urban growth modeling, and population estimates. Students will read and critically evaluate current literature on these topics and have the opportunity to conduct their own independent research on case studies relevant to the course topics.
Learning outcomes	After completing this course, students will be able to: • apply the knowledge and techniques required for solving urban and environmental problems. • demonstrate understanding of how to collect geospatial data for comprehensive urban and environmental studies. • use geoinformatics in solving urban and environmental problems through execution of a term project and presenting it both orally and in written form.
Syllabus (List of lessons)	• Climate change, drought, Air pollution • Soil management (soil erosion, soil contamination) • Natural hazards (mass wasting, earthquakes, floods, etc) • Water resources (Groundwater vulnerability modeling) • Land use and land cover changes • Biodiversity/patch analysis • Urban planning, urban sprawl analysis, urban growth modeling • Population estimation • Network Analysis
Prerequisite	Remote Sensing and Photogrammetry Geospatial Data Analysis
Course literature	• Bajjali, W. 2018. **ArcGIS for Environmental and Water Issues.** 1st ed, 353 pages. Springer International Publishing.Print ISBN: 978-3-319-61157-0. Electronic ISBN: 978-3-319-61158-7. • Singleton A., Spielman, S., Folch, D. 2018. **Urban Analytics (Spatial Analytics and GIS),** 1st ed, 200 pages. SAGE Publishing. ISBN-10: 1473958636, ISBN-13: 978-1473958630. • Kolios**, S.,** Vorobev**, A.V.,** Vorobeva**, G.R.,** Stylios**,** C. 2017. **GIS and Environmental Monitoring: Applications in the Marine, Atmospheric and Geomagnetic Fields** (Geotechnologies and the Environment). 1 st ed, 174 pages. Springer International Publishing. ISBN 978-3-319-53086-4. • Zhu, X . 2016. **GIS for Environmental Applications A practical approach.** 1st ed, 490 pages. Routledge. ISBN: 0415829070, ISBN: 978-0415829076. • Xian, G. 2015. **Remote Sensing Applications for the Urban Environment** (Remote Sensing Applications Series) 1st Edition. Taylor and Francis, 234 pages. ISBN 9781420089844.

Course Name	Geo-application Development
Credit Hours	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description:	The course teaches the basic concepts of programming using selected programming language such as Python for solving problem related to geospatial information. this course includes practical lab with exercises aiming at developing programming skills and applying those skills to various geospatial and environmental problems.
Learning Outcomes:	After completing this course, students will be able to: • explain basic programming terms and concepts. • write programming codes to perform specific tasks within geoinformatics. • identify requirements of data, programming tools and functions, according to specific application tasks. • access programs and scripts available from various sources and embody them within geoinformatics application to be built-upon.
Syllabus (List of lessons)	• Basic concepts of Python computer programming • Variables, arithmetic and modules • Version Control and GitHub • Data types, lists and indices, objects, loops • Python Functions • Basics of data visualization • Pandas library for data analysis: introduction to DataFrames; read, write and processing data files. Practical exercises. • Introduction to Python for geospatial (advantages, available tools) • Shapely module: create geometric objects (Points, LineStrings, Polygons, Geometry Collections), explore attribute and functions. Practical exercise.
Prerequisite	Remote Sensing and Photogrammetry Geospatial Data Analysis
Course literature	• Zandbergen, Paul A. 2018. **Python scripting for ArcGIS.** 3rd ed, 538 pages. Springer International Publishing. Print ISBN: 3319792504. Electronic ISBN: 9783319792507. • Matthes,E. 2017. **Python Crash Course: A Hands-On, Project-Based Introduction to Programming**. 1st ed, 560 pages.No starch press. Print ISBN: 1593276036. • Lawhead, J. 2015. **Learning Geospatial Analysis with Python**. 2nd ed, 364 pages. Packt Publishing. Print ISBN: 9781783281138. • Westra, E. 2015. **Python Geospatial Analysis Essentials**. 1st ed, 180 Pages. Packt Publishing. Print ISBN**:** 978-1782174516. • Dorman, M. 2014. **Learning R for Geospatial Analysis**. 1st ed, 330 pages. Packt Publishing. Print ISBN-13**:** 978-1783984367.

Course name	Web GIS and Geo-services
Credit Hours:	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description:	This course focuses on the basics of web-GIS system architecture, geospatial web services, and mash-ups. It introduces the key elements of mobile GIS solutions, the functionality of geo-portals and web technologies, web mapping interoperability utilizing universal data standards, and new concepts in CyberGIS.
Learning Outcomes:	After completing this course, students will be able to: • deal with the technology related to Web GIS services • follow up with the up-to-date services in Web GIS • differentiate between the variuos Web-GIS services and their usage • apply web GIS to theoretical and practical cases.
Syllabus (List of lessons)	• Web GIS basics, applications, and services • Cloud GIS • Standards for distributed GIS services • Story maps and web app templates • ArcGIS Web AppBuilder • Mobile GIS • Real-time Web GIS • Spatial Analysis online • 3D Web GIS • Geoprocessing services
Prerequisite	Geospatial Data Analysis
Course literature	• Fu, H. 2018. **Getting to know Web GIS**. 3rd ed, 472 pages. ESRI Press. Print ISBN: 978-1589485211. • Tiwari, A. & Jain, K. 2017. **Concepts and applications of Web GIS.** 1st ed, 322 pages. Nova Science Pub Inc. Print ISBN-13: 978-1536127799. • See, L., Foody, G., Fritz, S., Mooney, P., Olteanu-Raimond, A.M., da Costa Fonte, C.M.P., Antoniou, V. and Fonte, C.C., 2017. **Mapping and the Citizen Sensor**. Ubiquity Press. 389 pages. ISBN: 978-1-911529-16-3. • Sheehan, M. 2015. **Developing Mobile Web ArcGIS Applications**. 1st ed, 146 pages. Packt Publishing Ltd. Print ISBN**:** 978-1784395797. • Li, S., Dragicevic, S., and Veenendaal, B (eds). 2011. **Advances in Web-based GIS, Mapping Services and Applications.** CRC Press; 1 edition, 400 pages. ISBN-10: 9780415804837, ISBN-13: 978-0415804837.

Course Name	Engineering Surveying
Credit Hours:	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description:	This course aims at giving students some surveying skills to support planning, operating, and processing of high-precision surveying measurements. Students are provided with methods and practical training on instruments for surveying and monitoring, including levelling, total station, GNSS and terrestrial laser scanning. Applications will include mapping of natural and man-made features, stakeout, and deformation monitoring infrastructures and geological hazards (e.g., landslide, faults movements etc.).
Learning Outcomes:	After completing this course, students will be able to: • use surveying instruments such as levelling, total station, GNSS and terrestrial laser scanning. • stakeout man-made and natural features. • implement surveying calculations. • design altimetric and 3D surveying and GNSS networks. • apply knowledge for deformation monitoring and change detection. • presnt and dispaly data using appropriate methods.
Syllabus (List of lessons)	• Introduction to the course with overview on the topics to be taught. • Geodetic (levelling and total station) and GNSS techniques for surveying: sensors, network design, data processing and quality assessment, lab experience. • Pre-processing and adjustment of geodetic networks, lab experience. • Terrestrial Laser Scanning techniques, lab experience. • Point cloud processing: pre-editing, registration and georeferencing, filtering and subsampling, change detection, primitive interpolation, lab experience. • Geodetic/GNSS/Areal-based techniques for structural monitoring. • Staking-out of buildings and infrastructures based on geodetic and GNSS techniques.. • Engineering surveying for applications in constructions, geology and environment
Prerequisite	-None
Course literature	• Kennie, Tom JM, and Gordon Petrie. 2017. **Engineering surveying technology**. Taylor & Francis Group, CRC Press. 3st Ed. 493 pages. Print ISBN: 9781138408777. • Scaioni, M. 2015**. Modern technologies for landslide monitoring and prediction**. 1st ed. 249 pages. Springer. Print ISBN: 978-3-662-45931-7. Electronic ISBN: 978-3-662-45930-0. • Ghilani, Charles D., and Paul R. Wolf. 2014. **Elementary surveying**. 14th ed, 960 pages. Pearson. Print ISBN: 0133758885. Electronic ISBN: 978-0133758887. • Vosselman, G. and H.-G Maas. 2010. **Airborne and Terrestrial Laser Scanning**. 1st ed., 318 pages. CRC press. Print ISBN: 1439827982. Electronic ISBN: 9781439827987. • Schofield, W. and M. Breach. 2007. **Engineering Surveying**. Butterworth-Heinemann, Taylor & Francis,CRC Press. 6th Ed. 622 pages. Print ISBN: 0750669497. Electronic ISBN: 9780750669498.

Course Name	**Research Methods in Geoinformatics**
Credit Hours	3 CH (11 ECTS credits)
Course Description:	This course is designed to offer students concepts and instruments necessary to enhance their communication skills in public speaking, written communication (special emphasis on report and project proposals), and digital communication to facilitate their future career in geoinformatics**.**
Learning Outcomes:	After completing this course, students will be able to: • communicate effectively and professionally through writing, speaking, and listening. • explain the value of networking strategies relevant to professional development. apply networking strategies to demonstrate effective networking conversations and written communications. • demonstrate understanding of successful job interview process.
Syllabus (List of lessons)	• How to write a thesis (including thesis proposal, defining research, using bibliometric services, analysing discussing research results) • CV building. This module includes a training session based on analysis of CV and tips on how to write a good CV to raise career opportunities. • How to write an abstract • How to write competitive proposals. • Public speaking and pitching. This module includes how to present yourself and be prepared to present your idea/work to the public. • Digital communication • How to prepare and be prepared to an interview. • Negotiating technique and how to negotiate. • How to create and manage a team. Time management. • Goals settings. Networking.
Prerequisite	-None
Course literature	• Niles, S. and Harris-Bowlsbey, J. 2016. **Career Development Interventions.** 5th ed, 552 pages. Pearson. ISBN-10: 0134286308, ISBN-13: 978-0134286303. • Hamid, E. 2013**. How to Write a Research Proposal and a Thesis: A Manual for Students and Researchers.** 2nd ed, 62 pages. CreateSpace Independent Publishing Platform. ISBN-10: 9781482675054. • Cryer. P. 2006. **The Research Student's Guide To Success**.3r ed, 288 pages. Open University Press. ISBN-10: 0335221173, ISBN-13: 978-0335221172 • Schimel, J. 2012. **Writing science: how to write papers that get cited and proposals that get funded**. 1st ed, 240 pages. Oxford University Press. ISBN-13: 978-0199760244. • Gill, C. 2014. **Essential Writing Skills for College and Beyond**. Writer's Digest Books; 250 pages. ISBN-10: 1599637596, ISBN-13: 978-1599637594.

Course Name	Special Topics in Geo-informatics
Credit Hours:	3 CH (11 ECTS credits): 2 CH theoretical and 3 CH practical
Course Description:	This course fouceses on advanced knowledge and practical skills not gained in the other courses e.g. 3D analysis, spatial modeling,multiple regression, principal components analysis , clustering methods, and time series analysis. The course has also a lab component where students practice applying the analysis methods using a geoinformatics software.
Learning Outcomes:	At the end of this course, students will be able to: • explore new areas of geoinformatics. • learn advanced knowledge of geoinformatics.
Syllabus (List of lessons)	The course contents vary from one semester to another. The following list of spplications are example areas of further study: • Geosciences • Photogrammetry • Disaster Management • Water Resources Management • Digital Image Processing • Urban Planning • Environmental Management Techniques and methods may include: • 3D analysis • Hyper spectral data analysis • Geospatial modeling (cellular automata-based model) • Multiple regression • Principal components • Clustering methods • Ttime series analysis
Prerequisite	Dept. Approval
Course Literature	Selected Readings

Course Name	Environmental Systems
Credit Hours:	3 credits (3 hours theory) (11 ECTS credits)
Course Description:	This course introduces students into the environmental systems and its components and characteristics. It also give students problems of environmental systems, ecological succession and cycles of main elements. The course focuses on the impact of human activities and its mitigation.
Learning Outcomes:	At the end of this course, students will be able to: • Recognize the basics of environmental science • Identify environmental problems • Identify ecological succession • Understand the theories of life origin and human development • Understand the Biogeochemical cycles and human impact on the environment and mitigation • Distinguish between human and natural systems
Syllabus (List Of Lessons)	• Introduction to environmental science • Materials and energy • Origin of life on earth and human development • Environmental systems • Biogeochemical cycles • Human impact on the environment and mitigation • Human and natural systems
Prerequisite	-None
Course Literature	• Wright, R. and Boorse, D. 2016. **Environmental Science: Toward A Sustainable Future.** 13th Edition, 672 pages. Pearson. ISBN-10: 9780134011271, ISBN-13: 978-0134011271. • Bennett, J and Chorley, R. 2015. **Environmental Systems: Philosophy, Analysis and Control.** Reprint edition, 638 pages. **.** Princeton University Press;. ISBN-10: 0691628041. ISBN-13: 978-0691628042. • Enger, E and Smith, B. 2015. **Environmental Science**. 14th ed, 512 pages. McGraw-Hill Education. ISBN-10: 007353255X, ISBN-13: 978-0073532554. • Imura, Hidefumi. 2013. **Environmental Systems Studies**. 1st ed, 151 pages. Springer, eBook. ISBN 978-4-431-54126-4. • Kaufmann, R and Cutler J. 2007. Environmental Science. 1st ed, 576 pages. McGraw-Hill Higher Education- Science. ISBN-10: 0073311863, ISBN-13: 978-0073311869

Course Name:	**Advanced Environmental Geology**
Credit Hours:	3 credits (3 hours theory) (11 ECTS credits)
Course Description:	This course focuses on the fundamentals of physical geology (rock types, mineral identification, plate tectonics, etc.), with an emphasis on human interaction with their environment. We will explore natural processes and anthropogenic (human-impacted) effects on those processes in the context of natural hazards, natural resources and sustainability.
Learning Outcomes:	At the end of this course, students will be able to: • Explain the dynamic behavior of the Earth as a complex system. • Discuss issues related to human population growth and its impact on the natural world. • Describe the interactions between tectonic plates and volcanic eruptions and earthquakes. • Explain the ways that people contribute to and mitigate damage as a result of natural disasters like tsunamis, landslides, and flooding. • Discuss evidence of global climate change and possible impacts of anthropogenic warming. • Describe appropriate locations for waste disposal. • Explain the causes of soil, air and water pollution
Syllabus (List Of Lessons)	• Earth Materials, Earth's structure and plate tectonics • Earthquakes, Volcanoes, and Mass wasting • Streams, flooding and coastal flooding • Soil resources and Water resources • Mineral/Rock resources, Fossil fuels • Alternative energy resources • Pollution and waste disposal • Air resources (ozone hole, smog) • Global climate change
Prerequisite	-None
Course Literature	• Reichard, J. 2013. **Environmental Geology**. McGraw-Hill Education. 10th ed. 551 pages. Print ISBN: 0077791762. Electronic ISBN: 978-0077791766. • Hyndman D. and D. Hyndman. 2013. **Natural Hazards and Disasters**. Brooks/Cole. 4th Ed, 576pages. Print ISBN: 1133590810. Electronic ISBN: 978-1133590811 • Keller E.A. and D.E. DeVecchio. 2011. **Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes**. 3rd ed, 528 pages. Routledge. Print ISBN: 9780321662644. Electronic ISBN: 978-0321662644.

Course Name:	**Earthquakes**
Credit Hours:	3 credits (3 hours theory) (11 ECTS credits)
Course Description:	The course is designed to offer students deep knowledge on the mechanics of earthquakes and the seismic waves. The course introduces students into earthquakes hazard and risk assessment the methods of interpreting seismic data.
Learning Outcomes:	At the end of this course, students will be able to: • Understand the mechanics of earthquakes • Determine the locations of earthquakes • Assess the harardaa nd risk of earthquakes • Recognize the seismic activites in the Middle East adn Jordan • Interpret seismic data
Syllabus (List Of Lessons)	• The physics and mechanics of earthquakes • The seismic waves • Locating earthquakes and their depth • Earthquake recorders network??? • Earthquake hazard and risk assessment • Earthquake activities in the Middle East • Interpretation of the seismic data • using appropriate software
Prerequisite	-None
Course Literature	• Scholz C.H. 2019. **The Mechanics of Earthquakes and Faulting**, 3rd ed., Cambridge University Press. Online ISBN:9781316681473. • Udias A., Madariaga R., Buforn E. 2014. **Source Mechanisms of Earthquakes. Theory and Practice.** 311 pages. Cambridge University Press. ISBN-10: 9781107040274, ISBN-13: 978-1107040274 • Shearer, P. 2009**. Introduction to Seismology**, 2nd ed. Cambridge University Press, 412 pages. ISBN-10: 9781108009102, ISBN-13: 978-0521708425 • Betbeder-Matibet, J . 2008. **Seismic Engineering**. 448 pages. Wiley & Sons. ISBN-10 1848210264, ISBN-13 9781848210264. • Bolt, B. A. and Freeman, W. H. 2003. **Earthquakes.** 5th ed, 320 pages. ISBN-10: 0716756188, ISBN-13: 978-0716756187