

Curriculum for
Geoinformatics Engineering
Bachelor of Engineering Program

2020



Pakistan Engineering Council
&
Higher Education Commission
Islamabad





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OF
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PREFCE

The curriculum, with varying definitions, is said to be a roadmap or plan of teaching-learning process that students of an academic program are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching approaches, and assessment methodologies. Since knowledge in all fields and sectors is expanding at a faster pace and new disciplines are also emerging; it is imperative that curricula should be dynamic having regular review and updation.

The University Grants Commission (UGC) was the designated authority to develop, review and revise curricula beyond Class-XII vides Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled “Supervision of Curricula and Textbooks and Maintenance of Standard of Education”. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v). In compliance with the above provisions, the HEC has been undertaking the development of curricula for new/ emerging fields and revision of curricula after regular intervals through respective National Curriculum Revision Committees (NCRCs) until 2018.

As a policy change and expanding higher education base under HEC, the curriculum review and development task has been shifted to the respective regulators and HEIs. PEC also having mandate under its Act of Parliament and especially after attaining Washington Accord full signatory status and IPEA licensing authority, took up the challenge to review and develop the curricula for engineering programs based on Outcome-Based Education (OBE) System. PEC has therefore constituted an Engineering Curriculum Review and Development (ECRDC) and also subject ECRDCs comprising of eminent engineers and professionals from academia and industry to take up the task of curricula review and updation. Nevertheless, the basic templates developed by HEC NCRCs have been followed as guidelines.

Under OBE based curriculum review and development framework, PEC held national and regional levels stakeholders and industrial consultation workshops engaging HEIs, industry, technical and consulting organizations. The experts' feedback and suggestions were translated into the curriculum review process taking into consideration of the dynamics of technological advancement, industrial needs and management-cum-soft skills for engineering graduates.

This curriculum document would serve as a guideline whereas allowing HEIs to tame/ change within the framework by introducing courses in support of local/ required industrial demand as well as satisfying 12 GAs (Graduate Attributes) covering core and elective courses, considered as beauty of OBE system in the international environment. At the same time, this curriculum framework would fulfill our national, social and economic needs leading towards attainment of Sustainable Development Goals (SDGs-2030). It would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards.

1. Engineering Curriculum Review & Development Committee (ECRDC)

PEC in its efforts towards quality engineering education, took up the challenge of curriculum review and development for engineering programs after due consent of HEC. A high level Engineering Curriculum Review and Development Committee (ECRDC), led by Prof Engr Dr Fazal Ahmad Khalid, Chairman Punjab HEC/ Vice Chairman PEC, was constituted whereas other eminent members are from industry and academia to take up the task of curricula review and updation, besides developing curriculum for new/ emerging fields. The main responsibility of ECRDC is to oversee the entire curriculum review and development process while setting policies and guidelines for the subject ECRDCs working in their respective domains. The 1st meeting of main ECRDC was held on 29th June, 2018 at PEC HQ, Islamabad, wherein the Convener briefed the scope, objective and ToRs of the Committee and also formulated the subject ECRDCs comprising of eminent engineers and professionals from academia and industry.

- | | |
|---|----------|
| 1. Engr Prof Dr Fazal Ahmed Khalid
Convener, Metallurgy, Materials, Mining Engg & Allied Disciplines | Convener |
| 2. Engr Prof Dr Iftikhar Hussain
Convener Mechanical Engg & Allied Disciplines | Member |
| 3. Engr Prof Dr M. Younus Javed
Convener Electrical Engg & Allied Disciplines | Member |
| 4. Engr Malik Saleem Ullah Saeed
Convener Chemical Engg & Allied Disciplines | Member |
| 5. Engr Dr Wasim Khaliq
Convener, Civil Engg & Allied Discipline | Member |
| 6. Engr Dr Muhammad Ashraf
Convener, Agricultural Engg & Allied Disciplines | Member |

- | | | |
|-----|---|-----------|
| 7. | Engr Prof Dr Jameel Ahmed
Convener, Common to All (Non-Engg Component) | Member |
| 8. | Engr Muhammad Raza Chohan
Director General, HEC | Member |
| 9. | Engr Dr Nasir Mahmood Khan
Additional Registrar (Accreditation), PEC | Member |
| 10. | Engr Dr Ashfaq Ahmed Sheikh
Additional Registrar, CPD | Secretary |

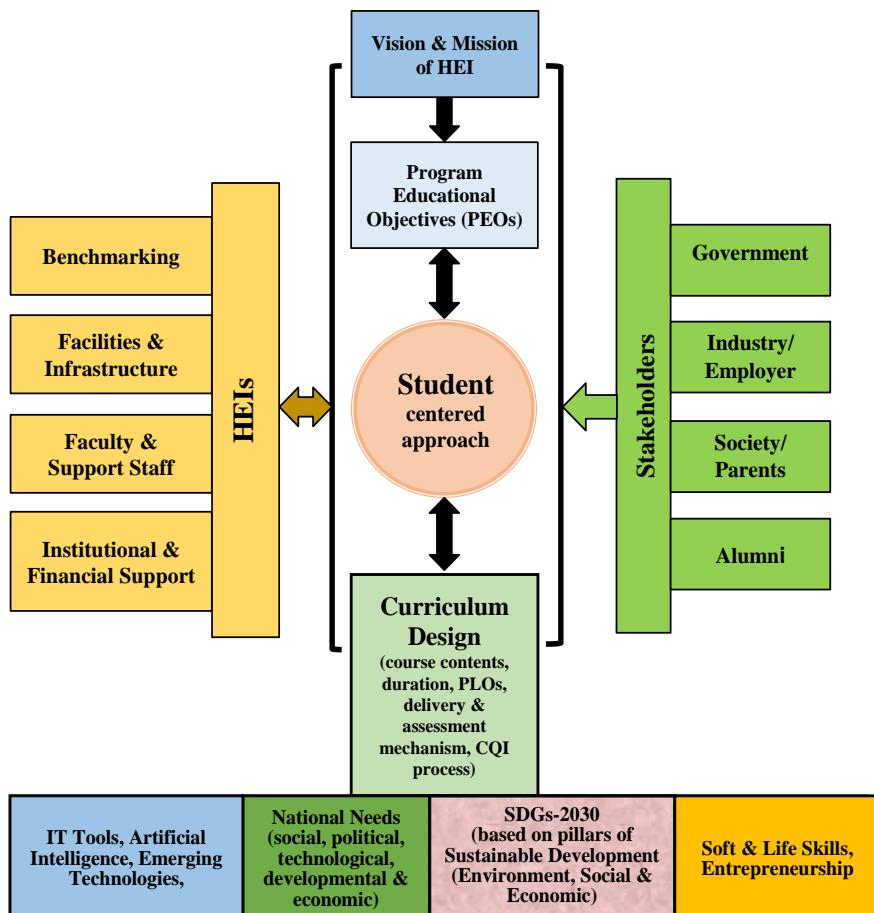
2. ECRDC Agenda

- The ECRDC is responsible to oversee the overall working of curriculum review and development for all engineering programs in terms of strategy, guidance and progress and thereby submission to the relevant forum for adoption/ notification.
- Each Member of ECRDC will also work in the capacity of Convener for respective disciplines as mentioned against their names and as per their ToRs.

3. OBE-Based Curriculum Development Framework

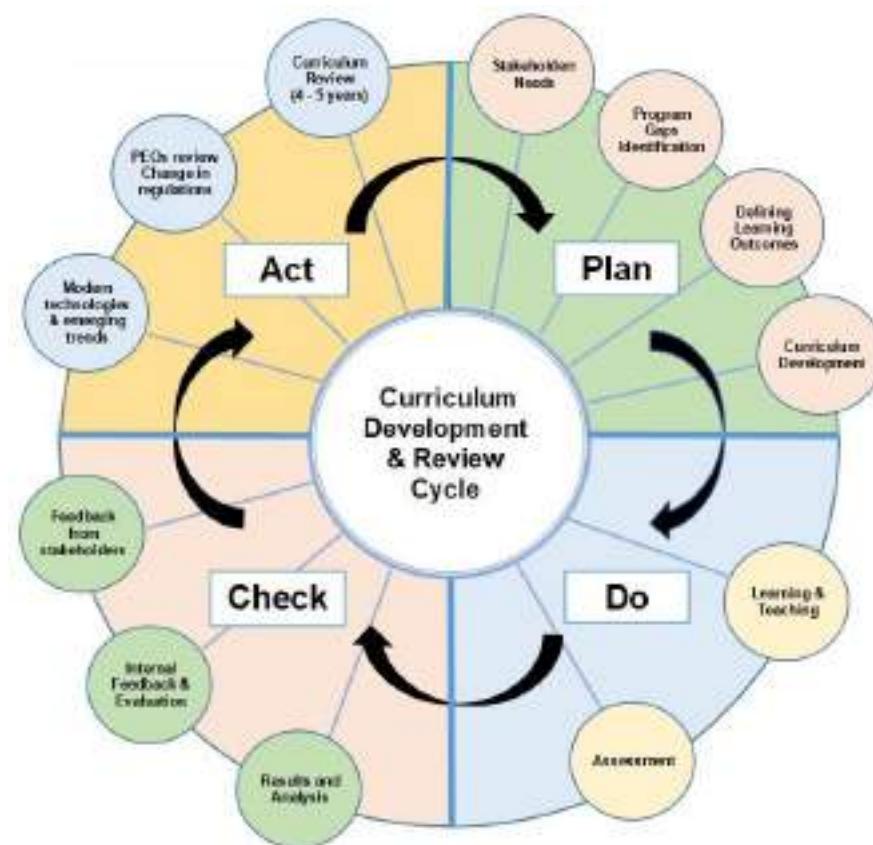
Outcome Based Education (OBE) is an approach of teaching and learning that focuses on what students should be able to attain at the end of the educational program. OBE is a student's centered system which concerns what the students will know and be able to do as learning outcomes. The curriculum development under OBE is therefore an integration of graduate attributes and stakeholders' feedback in cognizance with institution's Vision and Mission.

Outcome-Based Education (OBE) - Curriculum Development Framework



4. PDCA Approach to Curriculum Design and Development

The process of curriculum design and development constitutes various interconnected elements with the objective of achieving the intended purpose of the program. The Plan-Do-Check-Act approach (PDCA) as explained below has been followed in the curriculum development and review process.



Plan. This stage begins with an analysis of the stakeholders' needs of faculty, current and past students, employers and society in general. The stakeholders' needs are translated into human resource terminology i.e. graduate competencies which in turn translated into educational taxonomy and learning outcomes. Based on the learning outcomes, curriculum is designed backward to meet PLOs.

Do. The plan stage is implemented where curriculum is delivered and learning outcomes are assessed to gauge the achievement of PLOs.

Check. This stage involves the analysis of assessment results and feedback from students and faculty. Areas for improvement are identified.

Act. When the learning outcomes are achieved, the curriculum, learning and teaching strategies and assessment methods are standardized. Best practices are shared and improvement is made for the next cycle of PDCA.

5. ECRDC for Civil and Allied Engineering Disciplines

The PEC Engineering Curriculum Review and Development Committee (ECRDC) for Civil and Allied Engineering Disciplines took up the task to develop the curriculum for Bachelor of Geoinformatics Engineering degree program. The subject Committee had three meetings on 29-8-2019, 11-12-2019 and 14-01-2020 at PEC Headquarters Islamabad besides Sub-Group meetings. The Committee comprised of following members:

- | | | |
|----|--|----------|
| 1. | Engr Dr Wasim Khalid
Associate Professor
NICE
National University of Sciences and Technology (NUST)
Islamabad | Convener |
| 2. | Engr Prof Dr Abdul Jabbar Sangi
Associate Professor
Department of Civil Engineering
NED University of Engineering & Technology, Karachi | Member |
| 3. | Engr Dr Majid Ali
Associate Professor
Department of Civil Engineering
Capital University of Science and Technology, Islamabad. | Member |
| 4. | Engr Prof Dr Hamza Farooq Gabriel
Professor, NICE
National University of Sciences and Technology (NUST)
Islamabad | Member |

5. Engr Prof Dr Habib Ur Rehman Member
Professor
Department of Civil Engineering
UET, Lahore
6. Engr Prof Dr M Jamaluddin Thaheem Member
Assistant Professor
Construction Engineering and Management
National University of Sciences and Technology (NUST)
Islamabad
7. Engr Prof Dr Muhammad Zubair Abu Bakar Member
Dean, Professor
Department of Geology Engineering
UET, Lahore
8. Engr Dr Mazhar Iqbal Arshad Member
Associate Professor
Transportation and Geotechnical Engineering Department
Military College of Engineering MCE, Risalpur
9. Engr Dr Imran Hafeez Member
Professor
Department of Civil Engineering
UET, Taxila
10. Engr Haider Ali Khan Member
Principal
Faculty of Engineering
Lahore Leads University, Lahore
11. Engr Dr Izhar Ul Haq Member
Ex-President IEP
Lahore
12. Engr Ijaz Ahmed Cheema Member
Chief Engineer
Planning & Development
Provincial Highway Department, Lahore

13. Engr Prof Dr Bashir Alam Member
Professor
Department of Civil Engineering
UET, Peshawar
14. Engr Prof Dr Abdullah Saand Member
Dean Faculty of Engineering
Quaid-e-Awam University, Nawabshah
15. Engr Prof Dr Tauha Hussain Ali Member
Pro-Vice Chancellor
Mehran University of Engineering & Technology, Jamshoro
16. Engr Prof Dr Syed Mohammad Ali Member
Director, Earthquake Engineering Center (EEC)
University of Engineering and Technology (UET), Peshawar
17. Engr Prof Dr Muhammad Ashraf Tanoli Member
HoD, Deptt. of Civil Engineering
Ghulam Ishaq Khan Institute of
Engineering Sciences and Technology, Swabi
18. Engr Tariq Mehmood Member
Chief Engineer
WAPDA House, Lahore
19. Engr Abdul Qadeer Member
General Manager/Head
NESPAK House, Islamabad
20. Engr. Prof. Dr. Ali Rizwan Bukhari Member
Professor
Department of Civil Engineering
FAST University, Lahore
21. Mr. Hidayatullah Kasi Rep HEC
Deputy Director
Higher Education Commission, Islamabad
22. Engr. Dr. Ashfaq Ahmed Secretary
Additional Registrar
Pakistan Engineering Council, Islamabad

23. Engr. Muhammad Kashif Ali AR-CPD
Assistant Registrar
Pakistan Engineering Council, Islamabad

5.1 Sub Group Geoinformatics Engineering

- | | | |
|----|--|--------------------|
| 1. | Engr Prof Dr Abdul Jabbar Sangi
Professor
Department of Civil Engineering
NED University of Engineering & Technology, Karachi | Lead Sub-Group |
| 2. | Dr. Syed Imran Ahmed
Professor
Department of Civil Engineering
NED University of Engineering & Technology, Karachi | Expert |
| 3. | Engr. Dr. Ejaz Hussain
Associate Dean, Institute of Geographical Information Systems
National University of Sciences & Technology (NUST)
IGIS Building, NUST, Islamabad | Expert |
| 4. | Mr. Muhammad Ahmed
Assistant Professor
Department of Urban and Infrastructure Engg.
NED University of Engineering & Technology, Karachi | Expert |
| 5. | Mr. Shoaib Ahmed
Assistant Professor
Department of Civil Engineering
NED University of Engineering & Technology, Karachi | Expert |
| 6. | Mr. Hidayatullah Kasi
Deputy Director
Higher Education Commission, Islamabad | HEC Representative |
| 7. | Engr. Dr. Ashfaq Ahmed
Additional Registrar
Pakistan Engineering Council, Islamabad | Secretary |

8. Engr. Muhammad Kashif Ali AR-CPD
Assistant Registrar
Pakistan Engineering Council, Islamabad

6. Agenda of ECRDC for Civil and Allied Engineering Disciplines

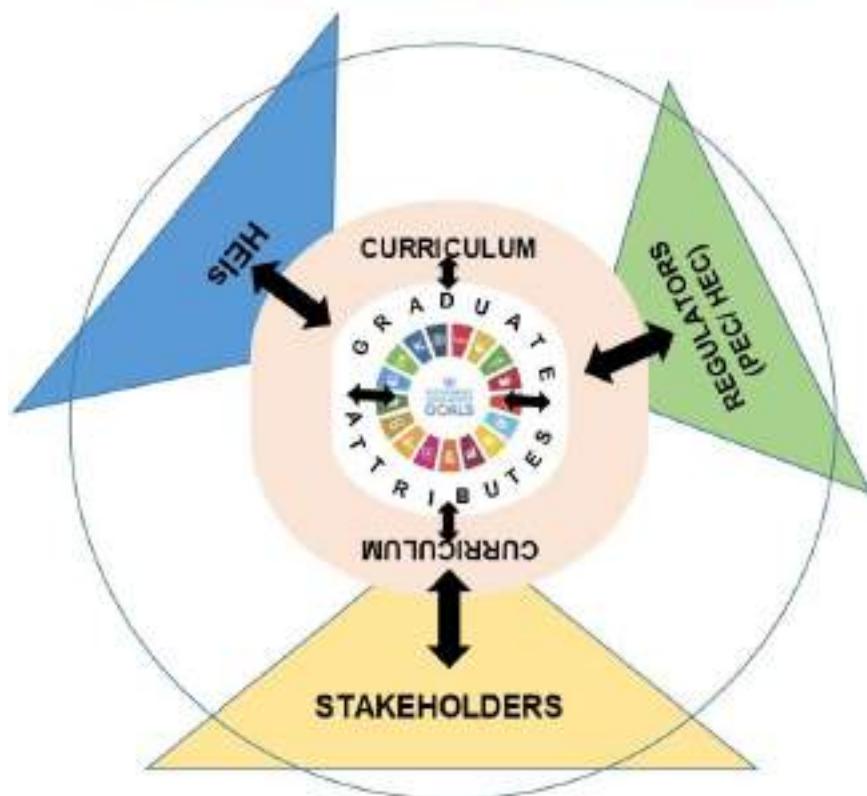
- The Subject ECRDC will work under the overall directions and supervision of main ECRDC, comprising of all Conveners
- The key driving lines for the development of engineering curriculum for each discipline will be the overall policy of Pakistan Engineering Council in connection with international commitments (Washington Accord, IPEA etc.) and Government polices
- Review of polices and stakeholders' feedback relating sector relevant to the respective discipline
- Comparative study of curricula being offered at various engineering universities/institutions following OBE-based system
- Development and finalization of complete scheme and curriculum for respective discipline including all aspects.

Engr Dr. Wasim Khaliq, the Convener highlighted the important benchmarks and international best practices to be considered for the revision of the curriculum while taking into account the Outcome Based Education (OBE) system. He also suggested that the Committee comprising professors and experts from academia, industry and R&D institutions has provided a useful input and suggestions covering new developments to be incorporated in the curriculum. He also highlighted the importance of the field of Geoinformatics Engineering for achieving sustainable developments while addressing socio-economic issues and challenges envisaged in SDGs-2030 as under and well mapped within curriculum;

- Goal-1: No Poverty
- Goal-2: Zero Hunger
- Goal-3: Good Health and Well-being
- Goal-4: Quality Education
- Goal-5: Gender Equality

- Goal-8: Decent Work and Economic Growth
- Goal-9: Industrial Innovation and Infrastructure
- Goal-11: Sustainable Cities and Communities
- Goal-12: Responsible Consumption and Production
- Goal-13: Climate Action

OBE Curriculum towards SDGs-2030 Attainment



The curriculum therefore has been designed based on above SDGs translating into program objectives and mapped with the scheme of study.

7. Program Educational Objectives (PEOs) and Learning Outcomes (PLOs)

As guidance, the sample Program Educational Objectives (PEOs) and Learning Outcomes (PLOs) are given below for a typical Geoinformatics Engineering Program. The HEIs should have their own program objectives, PLOs and CLOs in line with the institution's Vision and Mission, in cognizance with industrial needs as well as national and international trends.

7.1 Program Educational Objectives (PEOs)

The program aims at imparting quality education to Geoinformatics Engineering graduates for contributing to the society through modern technologies and practices in line with SDGs especially Goal-1, Goal-2, Goal-3, Goal-4, Goal-5, Goal-8, Goal-9, Goal-11 Goal-12, and Goal-13.

- i. Geoinformatics engineering professionals will:
- ii. Demonstrate sound knowledge and skills.
- iii. Work, manage and illustrate effective teamwork, interpersonal skills and professional growth.
- iv. Undertake professional practice considering ethical, societal and environmental implications.

7.2 Program Learning Outcomes (PLOs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitude that the students acquire while progressing through the program. The program must demonstrate that by the time of graduation the students have attained a certain set of knowledge, skills and behavioral traits, at least to some acceptable minimum level.

The sample Program Learning Outcomes (PLOs) of Geoinformatics Engineering are based on graduate attributes of PEC Accreditation Manual 2019 and are given below:

PLO-01: Engineering Knowledge: Ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO-02: Problem Analysis: Ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PLO-03: Design/Development of Solutions: Ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO-04: Investigation: Ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO-05: Modern Tool Usage: Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PLO-06: The Engineer and Society: Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO-07: Environment and Sustainability: Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for, sustainable development.

PLO-08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-09: Individual and Team Work: Ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.

PLO-10: Communication: Ability to communicate effectively, orally as well as in writing on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions.

PLO-11: Project Management: Ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team to manage projects in a multidisciplinary environment.

PLO-12: Lifelong Learning: Ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

8. Program Salient Features

The undergraduate engineering program has been based on the following salient features:

- **Duration:** 4 years
- **Number of Semesters:** 8
- **Total number of credit hours:** 130 - 136
 - Engineering Domain: minimum 85 Credit Hours
 - Non-Engineering Domain: minimum 30 Credit Hours

(HEIs have flexibility of 15-21 Credit Hours to add courses either in Engineering, Non-Engineering or both Domains to fulfill the program objectives in line with the overall Vision/ Mission of the Institute concerned).
- **Additional Course or Credit Hours Requirements:** Any addition of course or credit hour requirements as per direction or policy of the Government (Provincial or Federal), HEIs have leverage to cater such needs over and above the prescribed requirements in this document.
- **Number of weeks per semester:** 15 - 18
- **Number of credit hours per semester:** 15 - 18
- **Curriculum:** The engineering curriculum is the most important instrument for grooming the students based on 12 Graduate Attributes (GAs) encompassed under the Program Learning Outcomes (PLOs). In order to inculcate different dimensions of thinking – mathematical, computational, design and creative – among students in Cognitive,

Psychomotor and Affective domains, the curriculum is based on the following knowledge profiles:

- WK1 - Natural Sciences:** A systematic theory-based understanding of natural sciences applicable to the discipline.
- WK2 - Mathematics and Computing:** The concept-based mathematical thinking, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modeling applicable to the discipline.
- WK3 - Engineering Fundamentals:** A systematic, theory-based formulation of engineering fundamentals required in an engineering discipline.
- WK4 - Engineering Specialization:** The knowledge of engineering specialization that provides theoretical frameworks and bodies of knowledge for the accepted practice areas that are at the forefront in a discipline.
- WK5 - Engineering Design:** The Design Thinking Knowledge that supports engineering design in a practice area of an engineering discipline.
- WK6 - Engineering Practice:** The Knowledge of engineering practices (technology) in different practice areas of an engineering discipline.
- WK7 - Engineering in Society:** A systematic, comprehension-based knowledge of the role of engineers in a society and the professional issues related to practicing engineering profession in a discipline: ethics and the professional responsibility of an engineer to public safety including the impact of an engineering activity i.e. economic, social, cultural, and environmental and sustainability
- WK8 - Research Literature:** Engagement with selected knowledge in the research literature of the discipline.

The curriculum matrix covering above knowledge profiles should therefore be composed of non-engineering domain (humanities, math, management and natural sciences), and engineering domain with computer science, foundation, breadth, depth and multidisciplinary courses (including safety) so that different streams could be encouraged within each discipline, enabling students to undertake a range of **Complex Problem Solving** and **Complex Engineering Activities**. The students may select electives from any of the streams with guidelines from their respective advisors.

Knowledge Profile* (WK-1 to WK-8)	Knowledge Area	Sub-Area	Courses	Credit Hours
Non-Engineering Domain				
WK-2	Natural Science	Math	As per program requirements	12 - 15
WK-1		Physics	Applied Physics	6 - 9
		Natural Science/Math Elective	As per program requirements	
WK-7	Humanities	English	Written, communication and presentation skills	4 - 7
		Culture	Islamic Studies and Ethics	2
			Pakistan Studies and Global Perspective	2
		Social Science	Social and soft skills	2 - 6
	Management Sciences	Professional Practice	Professional and Project Management	2 - 6
Total (Non-Engineering Domain)				min 30
Engineering Domain				
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Science	ICT/AI/ Data Science/ Cyber Security		6 - 9

WK-3/ WK-2	Foundation Engg Courses		Specific to program objectives and outcomes	22 – 24
WK-4/ WK-2/ WK-1	Core Breadth of Engg discipline		Specific to program objectives and outcomes	23 – 24
WK-5/ WK-6	Core Depth of Engg Discipline		Specific to program objectives and outcome	22 – 24
WK-1/ WK-2/ WK-3/ WK-4	Multidisciplinary Engg Courses		Specific to program objectives and outcome	6 – 12
			Occupational Health and Safety (mandatory- 01 Cr Hr) (during 1st year of program)	
WK-6/ WK-8/ WK-7	Final Year Design Project (FYDP/ Capstone)	Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year.		6
WK-6/ WK-7	Industrial Training	at least 6 - 8 weeks internship		Qualifying
WK-4/ WK-5/ WK-6/ WK-7/ WK-8/ WK-2	Innovative and Critical Thinking (under relevant courses): - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open Ended Labs - Problem Based Learning			
Total (Engineering domain)				min 85
Total (Credit Hours)				130 – 136

* As a specific or more than one knowledge profile to be covered.

- **Industrial Training:** Internship of at least 6 - 8 weeks is mandatory part of degree requirements towards 3rd to 4th year of program; must be supervised, monitored, evaluated, and reflected in the transcripts under a prescribed mechanism and with defined and mapped rubrics with program objectives;
 - Selection of internship in line with elective subjects/ specific streams
 - Qualifying weightage: 70%

- At least 75% attendance is mandatory 10%
 - Assessment report from the employer 50%
 - Evaluation at relevant HEIs/ Deptt – presentation 40%
- **Final Year Design Project (FYDP)/ Capstone:** FYDP aims to challenge innovative, creative, technical, management and presentation skills of a graduate to bring together the learning over the degree program.
 - A final year design project (FYDP) is the confluence of an engineering program. Undertaking a final year design project is a compulsory requirement. It should mainly comprise literature search, individual analysis, modeling and simulation, AI (Artificial Intelligence) and computational data analytics, design and putting together various hardware, software, firmware and Algorithm Engineering / Informatics related to the program to demonstrate a functional concept including rapid prototyping, where applicable.
 - The FYDP shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specific needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
 - A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, projects of multidisciplinary nature should be encouraged.
 - The FYDP should span over two consecutive semesters, i.e. semester 7 & 8, totaling 6-credit hours and should be fully supervised, assessed and reflected in the transcripts under a prescribed mechanism so as to prepare for joining industry after graduation.
- **Faculty:** The faculty must be trained for the Outcome-Based Education (OBE) system. Their familiarity with the program objectives and outcomes, understanding of the Outcome-Based Assessment (OBA) cycle, enthusiasm for developing an effective program, and the ability to become an active player in this regard are the keys to ensure the attainment of program objectives. The faculty is expected to have the ability to ensure proper implementation of the program, and to develop processes for evaluation, assessment and CQI. A formal training program to groom the faculty should be instituted to become effective instructors in applying

pedagogical skills in all aspects of Teaching, Learning and Assessment covering all domains of Knowledge, Skills and Attitude.

- **Personal Grooming:** Personal Grooming of young faculty members and students is very important in order to develop and support their professional skills. Therefore, it is required that HEIs should conduct/arrange sessions or counseling hours on regular basis to provide guidance for personal grooming. Personal Grooming is important for positive self-image and increasing the confidence level of the individuals. It would help in enhancing students' self-esteem and would go a long way in developing an attractive personality by adopting habits like personal hygiene, clothing, appearance, interaction and expressive skills, etc. The students should be motivated and equipped to be entrepreneurs in their relevant field.
- **Presentation and Communication Skills:** Special focus should be given to inculcate communication and presentation skills amongst the graduates through individual and group presentations, technical writing and discussions, throughout the program as a regular feature.

This curriculum has been designed to guide and facilitate the universities and departments to formulate their own programs according to the industrial needs, emerging trends and recent developments in the field of Geoinformatics Engineering. The HEIs have flexibility to incorporate changes in the proposed curriculum within given range of credit hours for engineering and non-engineering domain.

9. Framework for Bachelor of Geoinformatics Engineering

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub Area	Name of Course	Theory	Lab	Total	
				Credit Hours			
Non-Engineering Domain							
WK-7	Humanities	English	Functional English	2	0	2	
			Technical Writing & Presentation Skills	2	0	2	
			Communication Skills	2	0	2	
		Culture	Islamic Studies and Ethics	2	0	2	
			Pakistan Studies and Global Perspective	2	0	2	
		Social Sciences	Elective-I (Sociology for Engineers/ Community Service/)	2	0	2	
			Elective-II (Engg Economics)	2	0	2	
			Elective-III (Professional Ethics)	2	0	2	
		Management Sciences	Professional Practice	Elective-I (Geospatial Project Management)	2	0	2
				Elective-II (Entrepreneurship)	2	0	2
WK-2 WK-1	Natural Sciences	Mathematics	Calculus and Analytical Geometry	3	0	3	
			Differential Equations	3	0	3	
			Linear Algebra	3	0	3	
			Probability and Statistics	3	0	3	
			Numerical Analysis	2	0	2	
		Physics	Applied Physics	2	1	3	
			Geography	3	0	3	

Curriculum of Geoinformatics Engineering

		Earth Sciences	Geosciences	3	0	3
Total (Non- Engineering Domain)			42	1	43	
Engineering Domain						
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Sciences	ICT/AI/ Data Science/ Cyber Security	Object Oriented Programming	3	1	4
			Information and Communication Technologies (ICT)	2	1	3
			Data Structures and Algorithms	3	1	4
WK-3/ WK-2	Engineering Foundation	--	Workshop Practice	0	1	1
			Surveying-I	2	1	3
			Engineering Drawing	0	2	2
			Soil Mechanics	2	1	3
			Database Management Systems	2	1	3
WK-4/ WK-2/ WK-1	Major Based Core (Breadth)	--	Introduction to Remote Sensing	2	1	3
			Introduction to GIS	2	1	3
			Computer Aided Drawing	1	2	3
			Digital Mapping & Image Processing	2	1	3
			Photogrammetry	2	1	3
			Spatial Data Analysis	2	1	3
			Geodesy and Map Projections	2	1	3
WK-5/ WK-6	Major Based Core (Depth)	--	Cartography and Map Production	2	1	3
			GIS Applications	2	1	3
			Spatial Databases	2	1	3
			GPS Surveying	1	2	3
			Land use Planning	2	1	3

			Web GIS	2	1	3		
			Spatial Decision Support Systems	2	1	3		
WK-1/ WK-2/ WK-3/ WK-4	Multi-Disciplinary Engineering Electives	--	Elective I	3(2)	0(1)	3		
			Elective II	3(2)	0(1)	3		
			Elective III	3(2)	0(1)	3		
			Elective IV	3(2)	0(1)	3		
			Elective V	3(2)	0(1)	3		
			Elective VI	3(2)	0(1)	3		
			Elective VII	3(2)	0(1)	3		
			Occupational Health and Safety*	1	0	1		
WK-6/ WK-7/ WK-8	Final Year Project (FYP)/ Capstone	Industrial/ Innovative/ Creative Project	FYDP (Part-I)	0	3	3		
			FYDP (Part-II)	0	3	3		
WK-6/ WK-7	Industrial Training	At least 6 weeks mandatory internship		0	0	0		
WK-2/ WK-4/ WK-5/ WK-6/ WK-7/ WK-8	Innovative and Critical Thinking (under relevant courses)							
	<ul style="list-style-type: none"> - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open ended Labs - Problem Based learning (PBL) 							
	Total (Engineering Domain)				62(54)	31(38)		
	Total Credit Hours				104(96)	32(39)		

* to be taught during first year of program.

10. Scheme of Studies for Bachelor of Geoinformatics Engineering

Semester 1		
S.#	Course Title	Credit Hours
1	Functional English	2(2-0)
2	Information and Communication Technologies (ICT)	3(2-1)
3	Islamic Studies	2(2-0)
4	Calculus & Analytical Geometry	3(3-0)
5	Workshop Practice	1(0-1)
6	Applied Physics	3(2-1)
7	Geography	3(3-0)
8	Occupational Health and Safety	1(1-0)
Total		18(15-3)
Semester 2		
1	Introduction to GIS	3(2-1)
2	Pakistan Studies	2(2-0)
3	Linear Algebra	3(3-0)
4	Engineering Drawing	2(0-2)
5	Communication Skills	2(2-0)
6	Object Oriented Programming	4(3-1)
Total		16(12-4)
Semester 3		
1	Introduction to Remote Sensing	3(2-1)
2	Engineering Economics	2(2-0)
3	Surveying-I	3(2-1)
4	Differential Equations	3(3-0)
5	Data Structures and Algorithms	4(3-1)
6	Probability & Statistics	3(3-0)
Total		18(15-3)

Semester 4		
1	Computer Aided Drawing	3(1-2)
2	Digital Mapping & Image Processing	3(2-1)
3	Photogrammetry	3(2-1)
4	Spatial Data Analysis	3(2-1)
5	Technical Writing & Presentation Skills	2(2-0)
6	Soil Mechanics	3(2-1)
Total CHs		17(11-6)
Semester 5		
1	Cartography and Map Production	3(2-1)
2	Geodesy and Map Projections	3(2-1)
3	Database Management Systems	3(2-1)
4	Geosciences	3(3-0)
5	GIS Applications	3(2-1)
6	ID Elective I	3(3-0)
Total		18(14-4)
Semester 6		
1	Spatial Databases	3(2-1)
2	GPS Surveying	3(1-2)
3	Land use Planning	3(2-1)
4	Web GIS	3(2-1)
5	ID Elective II	3
6	ID Elective III	3
Total		18(13-5)
Semester 7		
1	Professional Ethics	2(2-0)
2	Spatial Decision Support Systems	3(2-1)
3	Project I (GI Design Project)	3(0-3)
4	ID Elective IV	3(3-0)
5	ID Elective V	3(3-0)
6	Geospatial Project Management	2(2-0)

Curriculum of Geoinformatics Engineering

7	Numerical Analysis	2(2-0)
	Total	18(14-4)
Semester 8		
1	Entrepreneurship	2(2-0)
2	Project II (GI Design Project)	3(0-3)
3	ID Elective VI	3(2-1)
4	ID Elective VII	3(3-0)
5	Sociology for Engineers/ Community Service	2(2-0)
	Total	13(9-4)
	Total Credit Hours	136

List of MDE Electives

Elective-I (Water Resources)

- Water Resources Engineering and Management
- Groundwater Management
- Waterlogging and Salinity
- Water Resources & Irrigation Engineering
- Irrigation Engineering
- River Engineering

Elective-II (Computer Sciences / Electronics Engineering)

- Data Warehousing and Data Mining
- Machine Learning
- Digital Image Processing
- Signals and Systems
- Web Technologies-I

Elective-III (Geoinformatics)

- GIS Programming
- Integrated Geo-Technologies

Elective-IV (Natural Resources Management)

- Introduction to Environmental Engineering
- Water Supply and Waste Water Engineering
- Elements of Weather
- Environmental Impact Assessment
- Renewable Energy Resources

Elective-V (Land Use Planning)

- Regional Planning and Management
- Introduction to Urban and Transport Planning
- Fundamentals of Urban Planning
- Land Information System
- Procurement Management

Elective-VI (Special Topics)

- Special Topic in GIS
- Special Topic in RS
- Integrated Modeling for Resource Management

Elective-VII (Inter-disciplinary)

- Construction Project Management
- Engineering Geology
- Solid waste management
- Integrated Modeling for Climate Change

Electives for Social Science

- Sociology for Engineers
- Professional Ethics
- Economics for Engineers
- Sociology
- Social Anthropology
- Understanding Psychology and Human
- Social Psychology
- Organizational Behavior
- Critical Thinking
- Philosophy

- Human Resource Development
- Culture and Society
- Engineering Law

Electives for Management Sciences

- Entrepreneurship
- Entrepreneurship and Marketing
- Engineering Project Management
- Principle of Management
- Engineering Management
- Quality Management Systems
- Textile Marketing
- Industrial Engineering and Management
- Total Quality Management
- Supply Chain Management
- Production Management

Courses for Computer Sciences

- Information and Communication Technologies (ICT)
- Artificial Intelligence
- Cyber Security
- Data Science
- Modeling and Simulation
- Computer Programming and Design

11. Program Specific Labs

The following labs specific to engineering discipline be ensured to cover relevant knowledge domains but not limited to;

- Surveying Lab
- Computer Lab
- Soil Mechanics Lab
- Water Resources Engineering Lab
- Environmental Engineering Lab
- Electronics Engineering Lab
- Project & Research Lab

12. Course Details and Teaching-Assessment Approaches

In the following sections, Course Outlines and teaching-assessment approaches are given for guidance based on a typical semester system. The instructors may adopt or adapt accordingly defining CLOs, course delivery plan, innovative teaching approaches and assessment techniques.

12.1 Engineering Domain

Computer and Information Sciences Courses

Object Oriented Programming

Course Outline:

- Pointers; Classes and Objects; Arrays and Strings/ Functions; Flow Control & Composite Data Types
- Inheritance; Case Study-Inheritance; Polymorphism; Event Driven Programming; Exception Handling & File Handling; Multithreading; Database Handling and Advanced Topics

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- C++: How to Program (7thEdition) by Harvey Deitel, PaulDeitel, 2010. ISBN: 8120340361
- Introduction to Programming Using Python, MIT Press, 2013.
- Object-Oriented Programming in C++ (4thEdition) by Robert Lafore, 2002. ISBN: 8131722821

Information and Communication Technologies (ICT)

Course Outline:

Introducing Computer Systems: Basic Definitions

- Computer and Communication Technology
- The applications of ICT - particularly for Engineers

Basic Operations and Components of a Generic Computer System

- Basic operations: Input, Processing, Output, Storage Basic components: Hardware, Software, Data, Users
- Types of storage devices

Processing Data

- Transforming data into information
- How computers represent and process data
- Processing Devices
- CPU architectures

The Internet

- The Internet and the World Wide Web- browsers, HTML
- URLs/ How DNS works
- Email and other programs

Introduction to Embedded Systems

- What is an Embedded System
- Applications
- Components
- Programming Languages
- Popular Development Platforms

Networking Basics

- Uses of networks
- Common types of networks (LAN, WAN, MAN etc.)
- Introduction to OSI Model
- Future of Networks

Database Management

- Hierarchy of Data
- Maintaining Data
- Database Management Systems

Exposure to ICT Tools and Blogs (Student Assignment)

Protecting your Privacy, your Computer and your Data

- Basic Security Concepts
- Threats to users
- Threats to hardware
- Threats to Data

ICT in Education

Future Trends in ICT

Final Presentations

Tools / Software Requirement

Microsoft Office, Windows, Virtual Box, Netbeans

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- “Introduction to Computers”, Peter Norton, 7th Edition, 2013, McGraw-Hill.
- “Computing Essentials”, Timothy O’Leary and Linda O’Leary, 2010, McGraw-Hill.
- “Using Information Technology: A Practical Introduction to Computers & Communications”, Williams Sawyer, 6th Edition, 2005, McGraw-Hill.

- “Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning” Shelly GB, Vermaat ME, 2012 Ed.

Computer Programming

Course Outline:

Introduction to Programming

- Introduction to Programming Language C++ / Visual BASIC (VB)
- The character set
- Constants, variables and keywords
- Rules of constructing integer
- Real and character constants
- Flow charts and Algorithms

The Loop Control Structure

- The for loop, Nesting of loops
- Multiple initializations in the for loop
- The while loops
- The break statements
- The continue statement
- The do-while loop

The Case Control Structure

- Decisions using switch
- Switch versus if-else ladder
- The go to keyword

Functions

- Function definition
- Passing values between functions
- Functions declaration and prototypes

Arrays and Strings

- Introduction to arrays and strings
- 2D arrays

Programming Languages

Programming for various Engineering Problems

Miscellaneous

- Introduction to pointers
- File handling
- Structures

Introduction to MS Office with advanced applications of MS Excel

Use of MATLAB

Teaching Methodology (Proposed as applicable):

Lecturing, Written Assignments/ Quizzes, Case Studies, Semester Project, Guest Speaker, Industrial Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Gottfried, BS Programming with Structured Basics (Schaum Series), McGraw-Hill. (Latest Edition)
- Deitel & Deitel, T.R. Nieto, Visual C++ 6 (Latest Edition)
- Steven Holzner , Black Book of C++ (Latest Edition)
- Evangelos Petroutsos, Mastering Visual Basic 6, Sybex Computer Books Inc. USA, 1998
- Stephen J. Chapman, MATLAB Programming for Engineers (Latest Edition)

Data Structures and Algorithms

Course Outline:

- Introduction to data structures and algorithms
- Array, linked list, singly linked list
- Doubly linked list, circular linked list
- Stacks and queues

- Dynamic Concept in running time complexity, function growth
- Recurrences and how to solve them, tree based and Master Method
- Sorting algorithms
- Sorting algorithms
- Introduction to trees
- Binary search tree operations
- AVL trees, priority queues
- Binary heaps, hash tables
- Introduction to graphs and search operations
- Topological sort, spanning trees; Dynamic Programming (Shortest paths and greedy algorithms)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Introduction to Algorithms, (3rd Edition) by T. H. Cormen, Charles E. Leiserson, R. L. Rivest, Clifford S, 2009.
- Data structures using C++, (2nd Edition) by D. S. Malik, 2016.
- The Algorithm Design Manual, (2nd Edition) by Steven S Skiena, 2008.
- Data Structures and Algorithm Analysis in C++, (3rd Edition) by Mark A. Weiss, 2006.
- Data Structures and Algorithms in C++, (3rd Edition) by Adam Drozdek, 2005.

Computer Aided Design

Course Outline:

- Introduction to AutoCAD
- Use basic drawing and text commands
- Use basic editing commands (move, copy, erase, etc.)
- Use advanced editing commands (mirror, fillet, etc.)
- Dimensioning capabilities of Auto CAD
- Create and use layers
- Print or plot a drawing
- Create and using blocks
- Be familiar with hatching capabilities of Auto CAD
- Curves
- 3D modeling
- Multiple Lines
- Geometric Shapes
- Isometric drawings
- Polar Arrays

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Mastering AutoCAD latest edition and AutoCAD LT by George Omura with Brian Benton, (latest edition),
- AutoCAD® latest edition And AutoCAD Ltd latest edition No Experience required by Donnie Gladfelter.

Introduction to Modeling and Simulation

Course Outline:

Simulation

- Prepare Model Inputs and Outputs
- Configure Simulation Conditions
- Run Simulations
- View and Analyze Simulation Results
- Test and Debug Simulations
- Optimize Performance
- Simulation Guidelines & Best Practices

Modeling

- Design Model Architecture
- Manage Design Data
- Design Model Behavior
- Configure Signals, States, and Parameters
- Configure Inputs and Visualizations
- Analyze and Remodel Design
- Test Model Components
- Modeling Guidelines & Best Practices

Tools/ Software Requirement

- Matlab

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introduction to Matlab for Engineering Students by David Houcque, Northwestern University latest edition.
- <https://www.mathworks.com/help/simulink/simulation.html>
- <https://www.mathworks.com/help/simulink/modeling.htm>

Artificial Intelligence

Course Outline:

This course gives a broad overview of the fundamental theories and techniques of Artificial Intelligence.

- Overview of AI Problems;
- Intelligent Behavior: Turing Test, Rationale versus Non-rationale Reasoning;
- Problem Characteristics: Fully versus Partially Observable,
- Single versus Multi agent; Intelligent Agents: reactive, deliberative, goal-driven, utility-driven, and learning agents; Uninformed Search: Depth First, Breadth First, Depth First with Iterative Deepening;
- Informed Search: Hill climbing, A*- Search and their Time and Space Complexity, Local Search, Genetic Algorithm; Game Playing: Minimax, Evaluation functions, Alpha-beta pruning; Propositional and Predicate Logic; Resolution and Theorem Proving; Forward and Backward Chaining;
- Machine Learning: Introduction,
- Supervised learning: Instance based learning, Decision tree, artificial neural networks, Unsupervised Learning: K-means Clustering, Reinforcement Learning.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Stuart J. Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, latest Edition, Prentice Hall, ISBN-13: 978-0136042594.
- Elaine Rich and Kevin Knight, “Artificial Intelligence”, latest Edition, McGraw-Hill, ISBN-13: 978-0070522633.
- R. J. Schalkoff, “Artificial Intelligence in Engineering Approach”, latest edition, McGraw Hill, ISBN-13: 978-0070550841.
- Peter Jackson, “Introduction to Expert Systems”, latest Edition, Addison Wesley, ISBN-13: 978-0201876864.
- Ivan Bratko, “Prolog Programming for Artificial Intelligence”, latest Edition, Addison Wesley, ISBN-13: 978-0321417466.

Engineering Foundation Courses

Workshop Practices

Course Outline:

Introduction to Workshop Technology

- Definitions and Terminologies
- Process of Manufacturing
- Industrial Safety
- Industrial Materials
- Manufacturing Standards
- Quality Control

Measuring Techniques

- Measuring System / Standards
- Manufacturing Metrology
- Limits, Fits Allowances and Tolerances
- Measuring Instruments and their Uses

Bench Fitting Practice

- Fib and Tolerances
- Filling Work, Jigs and Fixtures, Taps and Die work
- Drilling and Grinding, Marking and Punching

Machining Practice (Lathe)

- Types of Lathe Machines and Operations
- Cutting Tools, Accessories and Attachments
- Parts of lathe machines
- Safety Precautions

Machining Practice (Milling)

- Types of milling Machines and Operations
- Cutting Tools, Accessories and Attachments
- Parts of Milling Machine
- Safety Precautions

Pattern Making / Wood Work

- Introduction to wood and Classification
- Seasoning of Wood
- Engg application of wood
- Properties of wood and wood joints
- Pattern Making, Wood Defects
- Wood Working Tools and Machines

Forging Work

- Forging Tools
- Hot and Cold Forging
- Properties and Crystals, Structure of Metals
- Forging Types / Operations
- Safety Precautions

Foundry Work

- Introduction to Foundry
- Different methods of casting including latest techniques
- Different types of furnaces

- Mold and Die casting
- Casting defects
- Safety precautions

Electrical Technology

- Basic Electrical Technology
- Power Supply Circuits, Types of Cables and Insulators
- Electrical Tools and Instruments
- Basic Fault Diagnosis in Circuits
- Electrical Devices
- Electrical Shock prevention and treatment
- Electrical Safety Precautions

Welding Technology

- Introduction to Welding Theory
- Types of Welding, Welding Joints
- ARC Welding Techniques
- Gas Welding Techniques
- Safety Precautions

Sheet Metal Work / Fabrication

- Form and Size of Sheet Metals
- Shearing and Bending of Process
- Sheet Development and Marking
- Sheet Metal Joints
- Properties of Metals related to Sheet Forming
- Safety Precautions

Surface Treatment and Paint Work

- Electroplating Processes
- Electroplating Techniques
- Preparation of Work Piece (Degreasing and Pickling etc.)
- Solution preparation for plating and their environmental issues
- Paints and application
- Primers and Solvents

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Introduction to Workshop Technology by Engr. Muhammad Naweed Hassan
- Workshop Practice by W.A. J Chapman
- Welding Technology by Althouse

Surveying-I

Course Outline:

- Basic Concepts of Maps and Survey
- Introduction to survey
- How to make a scale line
- Establishment of control points by Traverse, computations and plotting.
- Plane Table Survey
- Levelling
- Contouring
- Road Alignment

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Survey & Levelling by T.P. Kanetkar and S.V. Kulkarni (Vol -I & Vol -II)
- Surveying Principles and Application by Barry Kavanagh
- Survey for Engineers by John Uren & Bill Price

Engineering Drawing

Course Outline:

- Introduction: Line types projection theory
- Drawing Instruments & geometric construction
- Orthographic projections
- Dimensioning
- Isometric Drawings
- Orthographic views of building drawings (For SCEE only) or Constructing Isometric drawings from projection & Auto CAD. (For remaining institutions)
- Sectional views of building drawings (For SCEE only) or Assembly drawing & identifying missing features & views (For remaining institutions), Select a machine and study its operation and machine elements detail. Draw the 3D model of the machine and draw 2D drawings. Apply the real mechanism to the machine

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- N.D Bhatt, Engineering Drawing and Graphics
- B. Wiebe, M. Mohler ,Technical Graphics Communication, McGraw-Hill

- Abbot, Practical Geometry & Engineering Graphics
- Craft, Meyers & Boyer, Engineering Graphics
- G. R. Bertoline, E. N. Wiebe, Technical Graphics Communication; McGraw-Hill
- F. Rogers, J.A. Adams; Mathematical Elements for Computer Graphics, McGraw-Hill A. C Parkinson, A First Year Engineering Drawing

Soil Mechanics

Course Outline:

- Introduction to soil physical properties, soil types, formation and nature of its constituents, physical properties.
- Mechanical soil analysis and field identification tests
- Engineering classification of soil
- Soil exploration purpose and procedures, Methods of soil exploration and in-situ soil tests
- Soil Plasticity, Soil Plasticity (Specific Gravity)
- Soil Compaction: Introduction, theory, and lab tests, Soil Compaction: Field Density Determination
- Soil Permeability, Seepage and Flow Nets
- Seepage Examples
- In-Situ Stresses, Stresses in Soil
- Consolidation mechanics and theory

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Principles of Geotechnical Engineering by Baraja M. Das (7th Edition), 2010, ISBN-13: 978-0-495-41130-7.
- Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy, 2002
- Introduction to Soil Mechanics by Baraja M. Das, 1979.
- Introduction to Geotechnical Engineering, (2nd Edition) by Robert D. Holtz, William D. Kovacs, Thomas C. Sheahan, 2010. ISBN: 0132496348.
- Basic Soil Mechanics (4th Edition) by R. Whitlow, 2000. ISBN: 0582381096
- Geotechnical Engineering: (Soil Mechanics) by Prof. T.G. Sitharam, Prof. T.N. Ramamurthy, 2011. ISBN: 812192457X
- Essentials of Soil Mechanics and Foundations: Basic Geotechnics (6th Edition) by David F. McCarthy, 2002. ISBN: 0130303836

Database Management Systems

Course Outline:

- Introduction to Database Management Systems / File Processing Systems
Database System Concepts and Architecture
- Database Modeling using Entity-Relationship, Normalization
- Relational Model, Relational Algebra, Relational Calculus.
- Query Languages: SQL, ,
- Design of Relational databases
- Schema Refinement
- Database design and implement
- Indexing and sorting, Query process
- Distributed Database/Database Security, Object Oriented, DBMS, Document Oriented DBMS, Spatial and Spatio-Temporal DBMS
- Data using and data warehousing, Web application using PHP and XML, Emerging Applications

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Modern Database Management, (10th Edition), Prentice Hall.
- Fundamentals of Database Systems, (6th Edition), by Elmaeri & Navathe, 2011, Addison-Wesley.
- (2nd Edition) by M. Kifer, A. Bernstein, and P.M. Lewis, Addison-Wesley, 2005, ISBN: 0-321-26845-8.
- Fundamentals of Database Systems, (4th Edition) by R. Elmasri and S. Navathe, 2003, Addison-Wesley, ISBN: 0-321-12226-7.
- Data base management systems, (3rd Edition) by Raghu Ramakrishna, McGraw Hill, ISBN Number 0-07-246563-8.
- Database Systems (7th Edition) by Rob, Coronel, Cengage Learning.

Engineering Breadth Courses

Introduction to Remote Sensing

Course Outline:

- Introduction and an overview of Remote Sensing, and its history
- Electromagnetic radiations, electromagnetic spectrum and its utilization for remote sensing
- Interaction EMR with atmosphere and Earth surface
- Spectral reflectance / response, and reflectance profiles, Soil, Water, Snow
- Spectral reflectance / response, and reflectance profiles, Vegetation and roads
- Types and characteristics of remote sensing platforms, remote sensing satellite orbits and swath

- Remote sensing sensors, data acquisition and transmission
- Digital Image, image resolutions, and data storage format
- Earth observation satellites systems (Low, medium and high resolution)
- Image histogram and descriptive Image Statistics
- Digital image pre-processing and visualization
- Introduction to Aerial and Thermal remote Sensing
- Field Specific Applications of Remote Sensing Data

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Introduction to Remote Sensing,(5th edition), James B. Campbell, (London, Taylor & Francis)
- Remote Sensing and Image Interpretation, (4th edition), Lillesand, T. and Kieffer, R.W. (London, John Wiley & Sons)
- Computer Processing of Remotely Sensed Images, An Introduction, 3rd edition, Paul, M Mather (2004), Wiley
- Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall, Jensen, J. R. (2002), New York

Introduction to GIS

Course Outline:

- Introduction to GIS, elements and components
- Legal aspects related to GIS
- Vector Data Models, Geo relational vector data model.
- Object based vector data model
- Raster Data Model, Types of raster data model
- Raster data structure, compression and conversion

- Data Acquisition, Existing GIS data, Meta data
- Creating new data and its conversion
- Coordinates and Map projections
- Georeferencing
- Spatial Data Editing
- Attribute data input and management
- Geocoding
- Visualization of geospatial data
- Data Exploration, Overview of GIS Application

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Getting to Know ArcGIS Desktop by Tim Ormsby, Eileen J. Napoleon, Robert Burke and Carolyn Groessl, 2010 ISBN: 1589482603
- Geographic Information Systems: A Management Perspective, (5th Edition) by Aronoff, S., 2004, WDL Publications, Ottawa, ISBN: 0912804008.
- Getting started with Geographic Information System, (2nd Edition) by Clarke, K., 2004, Prentice Hall, New York, ISBN – 1879102897.
- An introduction to Geographic Information System, (2nd Edition) by Heywood, I., Cornelius, S. and Carver, S., 2003, Addison Wesley Longman, New York, ISBN: 0130611980.
- Principles of Geographic Information Systems for Land Resources Management (2nd Edition) by Burrough, P. 2002, Oxford University Press, Oxford, ISBN: 0198233655.
- Principles of Geographic Information Systems by McDonald, R. and Burrough, P., 2001, Oxford University Press, Oxford, ISBN: 0198233855.

- The history of Geographic Information System by Foresman, T., 1997, Prentice Hall, New York. ISBN: 0138621454.

Computer Aided Drawing

Course Outline:

- Introduction to Engineering Drawing
- Managing space on drawing sheets
- Suitable engineering drawing projection, Perspective, Orthographic
- Introduction to CAD Environment
- Starting a new drawing, Use of command line, toolbars, opening of an existing drawing
- CAD's reference systems, unit system
- Basic drawing tools in CAD
- CAD tools for drawing accuracy and speed
- Advanced drawing tools in CAD
- CAD tools for editing drawings
- Data management tools such as extraction, addition
- Layout design, Printing properties
- Annotation tools to add additional information in drawing
- Interoperability among CAD and GIS data

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- AutoCAD for Architects, designers, and engineering, 2012, International Delhi. ISBN: 978-93-5004-121-5.
- Engineering Drawing by Dhananjay, A. Jolhe, 2010. ISBN: 0070648379

- Engineering Drawing by Arshad N. Siddiquee, Zahid A. Khan and Mukhtar Ahmad

Digital Mapping and Image Processing

Course Outline:

- Image Subsetting, Enhancement and colour balancing
- Radiometric and atmospheric corrections
- Geometric errors, Rectification, Geo-referencing and Image registration
- Image Enhancement (Band Ratios), Multiband Operations
- Image Enhancement (Vegetation Indices)
- Image Enhancement, Principal Components Analysis, Tasseled Cap Transformation
- Image Enhancement (Spatial Filtering, Image Transformation)
- Spatial Convolution Filtering (Low pass and high pass filters)
- Image Classification-Unsupervised
- Image Classification-Supervised
- Field data collection
- Sampling techniques

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Mather, P (2004). Computer processing of remotely sensed images. Third Edition, J Wiley.
- Jensen, J. R. (2002), Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall, and New York.
- Introduction to Remote Sensing, (5th Edition) by James B. Campbell, 2011, London, Taylor & Francis.

- Remote Sensing, Models and Methods for Image Processing (3rd Edition) by Schowengerdt, R.A., 2007, Academic Press, ISBN 978-0-12-369407-2.
- Digital Image Processing (3rd Edition) by Gonzalez (2008), Prentice Hall,
- Remote Sensing Digital Image Analysis (5th Edition) by John A. Richards
 - Xiuping Jia (2006), Springer-Verlag, Berlin Heidelberg.

Photogrammetry

Course Outline:

- Introduction of photogrammetry: Overview, History
- Principles of Photogrammetry-optics, Illuminance, Aperture, Photographic Films
- Filters, Photogrammetric Cameras and other imaging devices,
- Single lens camera, Frame aerial cameras
- Metric camera, Digital imaging devices, Camera calibration, Imaging geometry, Image motion compensation
- Image Measurements and Refinement: Coordinate Systems for measurements
- Methods of measuring photo coordinates, Refinement of measured photo coordinates, Distortions and Corrections
- Types and Characteristics of Aerial Photographs: Vertical / Tilted Aerial Photographs, Oblique Aerial Photograph, Mosaics.
- Perspective Projections
- Scale of photographs at flat and variable terrain
- Ground Coordinates from photographs
- Relief displacement and heights of objects, Error evaluation
- Stereoscopy and Parallax: Stereoscopic depth perception, Stereoscopes and their use, Parallax and parallax measurement
- Vertical exaggeration in stereo viewing, Stereoscopic Plotting Instruments, DEM Generation, Ortho-photography/Ortho-image
- Introduction to analytical and digital photogrammetry
- Ground Control for Aerial Photogrammetry- Number and location of photo control, Planning control survey, Methods for establishing control, Artificial targets for identification of control points

- Project Planning, Applications of Aerial photography

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Elements of Photogrammetry, (3rd Edition) by Paul R. Wolf & Bon A. Dewitt, 2004, McGraw Hill, ISBN: 007-133689-9
- Introduction to Modern Photography, (1st Edition) by Edward M. Mikhail, James S. Bathel, J. Chirs McGlone, 2001, John Wiley and Sons Inc, ISBN: 9780471309246
- Manual of Remote Sensing (2nd Edition) in 2 volumes by Colwell, R.N, 1983, American Society of Photogrammetry.
- Digital Photogrammetry, Tony Schenk, 1999, Terra Science USA, ISBN: 0-9677635 0-7
- Manual of Photographic Interpretation (2nd Edition), Philipson, W.R 1997, American Society for Photogrammetry and Remote Sensing.

Spatial Data Analysis

Course Outline:

- Introduction to spatial data types, Potentials of spatial data, and spatial statistics and analysis.
- Point pattern analysis, Lines and networks, Area, objects and spatial autocorrelation, types of area objects. Geometric properties of areas. Boundary analysis.
- Buffering and neighbourhood function. Proximity analysis. Neighbourhood Function/Analysis.
- Modelling and storing field data. Spatial interpolation, types, methods / algorithms. Derived measures on surfaces.

- Map overlay. Vector and raster overlay operations. Problems in simple Boolean polygon overlay.
- Multivariate data. Multidimensional space.
- Multivariate data. Multidimensional space.
- Distance, difference and similarity.
- Cluster analysis
- Principle Component Analysis PCA.
- New approaches to spatial analysis (Inverse Distance Weightage IDW; Kriging; Thin Plate Spline etc.)
- Interpolation techniques.
- Surface modelling, DTM/DEM.
- Multi-criteria and Multi-attribute modelling. Uncertainties in spatial modelling.
- Modern Trends in Spatial Data Analysis and Case Studies

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Christopher Lloyd (2010), Spatial Data Analysis: An Introduction for GIS users. Oxford University Press. ISBN: 0199554323
- Michael J de Smith, Michael F Goodchild and Paul A Longley (2007), Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools. 2nd Edition). The Winchelsea Press. ISBN: 1905886608
- Robert P. Haining (2003), Spatial Data Analysis: Theory and Practice. Cambridge University Press. ISBN: 0521774373
- Statistical Methods for Spatial Data Analysis (1st Edition) by Oliver Schabenberger Hardback, 2004. ISBN: 1584883227

Geodesy and Map Projections

Course Outline:

- An Introduction to Geodesy
- Historical perspective on Geodesy
- Functions, Branches and Observation Techniques of Geodesy
- Earth as a sphere, Geodesy in the current world
- Coordinate Reference Systems, Reference Frames and Datums- Definition of a Terrestrial Reference System (TRS), Satellite Laser Ranging, Very Long Baseline Interferometry
- Terrestrial Reference Frame and its related issues (Polar Motion, Position of Zero Meridian, Dynamics of Earth)
- Geometric Geodesy-Spherical Geometry and Coordinates, Distance along great and small circle arc
- Properties of Spherical Triangle, Spherical Excess, Legendre Theorem
- Ellipsoidal Geometry and Ellipsoidal Sections (Equator, Parallel, Meridian), Geodetic Coordinates, Prime Vertical Section, Normal Section
- Derivation of a relationship between geodetic latitude, geocentric latitude & reduced latitude
- Physical Geodesy-Gravity Field of the Earth, Geopotential, Units of Gravity and Geopotential, Gravimetry, Gravity Anomalies
- Isostasy
- Space Geodesy- Satellite Geodetic Measurement Techniques (Earth to Space Methods, Space to Earth Methods, Space to Space Methods, Kepler's Law).
- Map Projections -Classification of Projections, Distortions of Projections
- Quantification of Distortion and rectification, Datum Transformations, Examples of Modern Projects

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Smith, J. (1996). Introduction to geodesy. New York: Wiley. ISBN: 978-0471166603
- Melluish, R. (2014). Introduction to the mathematics of map projections. [Place of publication not identified]: Cambridge Univ Press. ISBN: 978-1107658486
- Torge, W., & Müller, J. (2012). Geodesy. Berlin: De Gruyter. ISBN: 978-3110207187
- Maling, D. (1992). Coordinate systems and map projections. Oxford: Pergamon Press. ISBN: 978-0080372334.

Engineering Depth Courses

Cartography and Map Production

Course Outline:

- Nature of Cartography
- History of Cartography
- Map Distortions
- Cartographic Design
- Color Theory and Models
- Color and Pattern use
- Typography and Lettering the Map
- Map Compilation
- Selection and Generalization Principles
- Symbolization
- Map Production, and latest trends
- Standards for land cover/land use classification schemes
- Cartography and Ethics
- Map Production in National and International Organizations (Survey of Pakistan, Food and Agriculture Organization (FAO), United States

Geological Survey (USGS), Coordination of Information on the Environment (CORINE).

- Latest Trends and Modern Cartographic Project Examples

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Cartography: Thematic Map Design (6th Edition) by Jeff Torguson and Thomas W. Hodler, 2008, W. C. Brown Pub. Co. ISBN13: 978-0072943825.
- Elements of Cartography, (6th Edition) by Robinson, A.H., Morrison, J.L., Muhrcke, A.J., Kimerling and Guptil, S.C., 1995, John Wiley & Sons, New York.
- Mapping: A Critical Introduction to Cartography and GIS by Crampton, Jeremy W. 2010. ISBN: 1405121726
- Thematic Cartography and Geographic Visualization, (2ndEdition) Slocum, Robert McMaster, Fritz Kessler, Hugh Howard, 2004, Terry. ISBN, 0130351237.
- Digital Cartography by Robert G. Cromley, 2003, Prentice Hall Inc.
- Cartography- Visualization Data by M.J. Kraak & F.J. Ormeling, 1996, Addison Wesley Longman Limited.
- Cartography, Visualization of Spatial Data (2ndEdition), by Menno-Jan Kraak, Ferjan Ormeling, 2002, ISBN 0130888907.
- Cartography with ArcView GIS and Map Projection, (5thEdition) 1998, AMAZON.
- Cartography: Thematic Map Design, (5thEdition), 1998, AMAZON.
- Multimedia Cartography, (1stEdition), 1999, AMAZON.

GIS Applications

Course Outline:

- Remote Sensing and GIS- Applications in Hazard and Natural Disaster- Types of Hazard and Disasters
- Hazard Assessment, Mapping and Mitigation
- Disaster Planning and Preparedness, Floods, Land Slides. Earthquake
- Case Studies
- Remote Sensing and GIS- Applications in Natural Resources -Managing Natural Resources
- Forestry, Case Studies
- Agriculture, Case Studies
- Remote Sensing and GIS- Applications in Health-Mapping Health Information
- Analyzing the Risk, Spread and Access to Health Facilities
- Case Studies
- Remote Sensing and GIS -Applications in Business-Concepts and theories of GIS in business
- Marketing Spatial Analysis and Site Suitability Analysis, Case Studies
- Remote Sensing and GIS -Applications in Utilities Management

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Wing M, Bettinger P. Geographic Information Systems. Don Mills, Ont.: Oxford University Press; 2008.
- Cromley E, McLafferty S. GIS and Public Health. New York: The Guilford Press; 2012.
- Lang L. Managing Natural Resources with GIS. Redlands, Calif.: Environmental Systems Research Institute; 1998.

- Longley P, Clarke G. GIS for Business and Service Planning. Cambridge: GeoInformation International; 1995.
- Maantay J, Ziegler J. GIS for the Urban Environment. Redlands, Calif.: ESRI Press; 2006.
- Tomaszewski B. Geographic Information Systems (GIS) For Disaster Management. 2014.

Spatial Databases

Course Outline:

- Introduction to spatial database, Information modelling, modelling approaches
- Information levels and frameworks
- Database system concepts and architecture, Conceptual modelling, ER diagrams
- Spatial databases, hardware and software architecture
- Representation of spatial objects, spatial data and spatial database systems, logical models and query language, constraint data model, computational geometry
- Spatial databases concepts, constrain data models
- Computational geometry, spatial Indexing, spatial operators, spatial relationships, spatial joins
- Projection w.r.t spatial database implementation
- Arc SDE, Versioning
- Polygon partitioning, Spatial database algorithms
- Simple query and complex query processing
- OpenGeo Suite and its components understanding. PgRouting conceptual framework
- OGC standards (SFS, WMS, WFS), Spatial database implementation with Web

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Spatial Database Systems, Design, Implementation and Project Management by A K.W. YEUNG and G. Brent Hall. Springer. 2007
- Modeling Our World: The ESRI Guide to Geodatabase Concepts (2nd Edition) by Michael Zeiler. 2010. ISBN: 1589482786
- Spatial Databases: With Application to GIS by Morgan Kaufmann by Rigaux, P. Scholl, M. and Voisard, A. 2002. ISBN:1-55860-588-6

GPS Surveying

Course Outline:

- Introduction to modern surveying
- Triangulation
- Trigonometric levelling
- Tachometry
- Surveying using total station
- Topographic mapping and alignment using total station
- Introduction to Micro Survey CAD software and its use for different survey applications
- GPS Surveys
- Technological developments leading to GNSS
- GNSS Constellation as control points
- Trilateration using GPS (as a complex form of triangulation)
- GPS signal structure (C/A and P-Code)
- GPS Errors and biases
- GRID I and GRID II for Pakistan
- Setting out of works

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- GPS for land surveyors by Van Sickle, J., 2008.
- Survey & Levelling by T.P. Kanetkar and S.V. Kulkarni (Vol -I & Vol -II)
- Surveying Principles and Applications by Barry Kavanagh
- Survey for Engineers by John Uren & Bill Price

Land Use Planning

Course Outline:

- Land Use concepts: Spatial dimensions of land use, scales in land use planning
- Land use concepts: community, regional, city-wide
- Steps in the plan making process
- Techniques for land use planning:
- Principles of planning, land use controls, models, zoning
- Techniques for land use planning: Zoning by law, minor variance, plans of subdivision
- Critical analysis of land use zoning of any existing city
- Mock public meetings
- Land use classification: Land evaluation,
- Land use data analysis
- Critical analysis of land use change analysis of any existing city
- Land use classification: Mapping techniques
- Site planning and Engineering, Impact Analysis: Social, Economic and Environmental

- Use of GIS and Remote Sensing: Pre-feasibility studies, suitable site selection
- Use of GIS and Remote Sensing: GIS for urban and rural planning, rural land use management

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Land Use Planning and Remote Sensing (Remote Sensing of Earth Resources and Environment) by David T. Lindgren (2010) ISBN: 9048182840.
- Smart Land-use Analysis: The LUCIS Model (Land-Use Conflict Identification Strategy) by Margaret H. Carr and Paul D. Zwick (2007). ESRI Map. ISBN: 978-1-58948-174-9.
- Site Analysis-A Contextual Approach to Sustainable Land Planning and Site Design by James A. LaGro Jr (2008). John Wiley and Sons, Inc. ISBN: 978-0-471-79798-2.
- Strategic Environmental Assessment and Land Use Planning: An International Evaluation. Edited by Carys Jones, Mark Baker, Jeremy Carter, Stephen Jay, Michael Short and Christopher Wood (2005). Earthscan. ISBN: 1-84407-109-3.
- Land use Modelling in Planning Practice by Eric Koomen, Judith Borsboom-van Beurden, 2011. Springer. The GeoJournal Library Vol 101.
- Donald Watson, Alan Plattus, Robert Shibley (2011), Time Saving Standards for Urban Design. Tata McGraw-Hill. ISBN-13: 978-1-25-900290-8.
- GIS in Land and Property Management by Martin P. Ralphs and Peter Wyatt (2003)

- Edward J. Kaiser, David R. Godschalk, F. Stuart, Jr. Chapin (1995) Urban Land Use Planning, 4th edition University of Illinois Press; ISBN: 0252021010.
- Town Planning in the Third World by Akhtar K. Bhatti (199). Ferozson (pvt) Ltd. ISBN: 969-0-10127-7.

Web GIS

Course Outline:

- Web GIS Introduction
- Web Terminologies
- Web 2.0/OGC Standards
- Open source Web GIS Solutions (OpenGeo Suite)
- Open Layers Concept (Map object, base layer, non-base layer, map controls, WMS Layer, Google, Bing and OSM)
- Web GIS Architecture
- Web Services and Geospatial Web Services
- Geospatial Mashups
- Geoportals
- NSDI
- OGC standards (WCS, WPS)
- Web GIS Trends
- Mobile GIS

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Fu, Pinde, and Jiulin Sun. Web GIS: principles and applications. Esri Press, 2010.

Spatial Decision Support System

Course Outline:

- Introduction to Decision Support System (DSS)
- The systems perspective of a DSS
- SDSS Introduction
- Evolution and Trends in SDSS
- Components of SDSS I
- Components of SDSS II
- Building SDSS Software
- Building Desktop and Web-based SDSS
- SDSS Modelling
- SDSS Applications
- Multi-criteria Decision Analysis, Spatial multi criteria decision analysis, Evaluation Criteria, Hierarchical structure of evaluation criteria, Criterion maps, Scale of measurement, Deriving commensurate criterions maps, Linear scale transformation, Value utility function, Probabilities and fuzzy sets
- SDSS Applications, Decision alternative and constraints, Criterion Weighting, Ranking methods, rating methods, Pairwise comparison method, Trade-off analysis method, Decision Rules,
- Multi attributes decision rules, Simple additive weighting methods, Analytical hierarchy process. Multi criteria decision support systems, spatial data processing systems, and spatial expert systems
- SDSS Challenges and Future Directions

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Spatial Decision Support Systems: Principles and Practices, Ramanathan Sugumaran, 2011. ISBN: 978-1-4200-6212-0
- GIS and Multicriteria Decision Analysis, Jacek Malczewski, 1999, ISBN:0-471-32944-4
- Decision Support Systems for Business Intelligence, 2nd Edition, Vicki L. Sauter, 2011, ISBN: 978-0-470-43374-4
- Decision Support Systems in the 21st century, George M. Marakas, 2004, Prentice Hall, India.

Multidisciplinary Engineering Courses

Elective-I (Water Resources)

Water Resource Engineering and Management

Course Outlines:

Part A – Surface Water Hydrology

Introduction

- Hydrological cycle
- Hydrologic equation
- Importance and practical applications of hydrology

Precipitation

- Types of precipitation
- Factors necessary for the formation of precipitation
- Measurement of precipitation
- Computation of Average Rainfall over a Basin

Runoff & Hydrograph

- Runoff & Factors Affecting Runoff
- Computation of Runoff
- Characteristics of hydrograph
- Components of a hydrograph

- Hydrograph separation
- Estimation of maximum rate of runoff
- Unit Hydrograph
- S-curve
- Discharge estimation by probabilistic method

Stream Flow Routing

- The phenomenon of flooding and its causes
- Frequency and duration analysis
- Reservoir & channel routing
- Methods of Stream Gauging
- Measurement of Stream Flow by Current Meter

Part B – Ground Water Hydrology

Basic Definitions & Law in Ground Water Hydrology

- Darcy's Law
- Differential Equation governing Ground Water Flow
- Interstices, Porosity, Specific Yield, Specific Retention, Storage Coefficient, Permeability & Transmissibility
- Water Yielding Properties
- Ground Water Reservoir
- Aquiclude, Aquifuge, Aquifer & Types of Aquifer
- Aquifer as Reservoir
- Aquifer as Conduit

Well Hydraulics

- Steady Radial Flow to Well in Confined & Unconfined Aquifers – Dupuit's Theory
- Assumptions & Limitations of Dupuit's Theory
- Well Losses
- Capacity of Well
- Interference among Wells

Tube Well Construction

- Tube Well Types
- Tube Well Construction

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Engineering Hydrology: An Introduction by Ghumman, A. R. (2006). Prosperous Pakistan Publishers, Lahore, Pakistan
- Hydrology: Principles, Analysis & Design by Raghunath, H.M. 1988, Wiley Eastern, India.
- Irrigation & Water Power Engineering by Punmia, B.C., 1984, Standard Publishers Distributors, New Dehli, India.
- Surface Water Hydrology, Vol 1 by Awan, N.M., 1981, National Book Foundation, Pakistan
- Engineering Hydrology (3rdEdition) by Subramanya, K., 2008. McGraw-Hill.
- Hydrology For Engineers, by Linsley R K, Kohler M A, and Paulhus L H., 1988Mcgraw Hill, Paperback

Water Resource and Irrigation Engineering

Course Outlines:

Water Resources of Pakistan

- Planning and development of water resources projects
- Domestic, Industrial, Agricultural and other water usages
- Water resources in Pakistan
- Indus Basin Treaty
- Indus Basin Irrigation System (IBIS)

Methods of Irrigation

- Definition, Need, Importance & Scope of Irrigation
- Types/Methods/Modes of Irrigation
- Merits & Demerits of Irrigation

Water Requirements of Crops

- Functions of Irrigation Water
- Standards & Classification of Irrigation Water
- Classes & Availability of Soil Water
- Soil Moisture Constants
- Soil-Moisture-Irrigation Relationship
- Principal Crops & Cropping Seasons of Pakistan
- Duty & Delta of Crops
- Intensity of Irrigation
- Irrigation Efficiencies
- Consumptive Use of Water (i.e. Evapotranspiration)
- Determination of Irrigation Requirement of Crops using Hargreaves Method

Diversion Headworks

- Weir, Barrage & Headwork
- Classes of Headwork (Storage & Diversion Headworks)
- Function of Diversion Headwork
- Classes of Diversion Headwork (Temporary Spurs, Permanent Weirs & Barrages)
- Component Parts of a Diversion Headwork (Layout of Diversion Headwork, Functions of each Component Parts)
- Causes of Failure of Weirs & their Remedies

Canal Irrigation System & Design of Irrigation Channel

- Alluvial & Non-alluvial Canals
- Classification of Canals
- Distribution System of Canal Irrigation in Pakistan
- Losses in Canals
- Selection of Canal Site, Layout & Alignment

Canal Control, Regulation, Operation, Measurement & Cross Drainage Works

- Canal Regulation Works, Types & Functions (Canal Head Regulator, Cross Regulator, Canal Escapes, Metering Flumes, Canal Outlets & Modules, Canal Falls)
- Irrigation Structures Worldwide (Storage, Conveyance, Diversion, Distribution, Control, Measurement, Safety, Transmission)
- Canal Operation & Control (Scheduled/Unscheduled Operation, Operational & Regulation Modes, Organization of Canal Operation, Upstream Control, Downstream Control, Volume Control Techniques)
- Canal Flow Measurements Techniques & Methods (Velocity/Head Measurements, Weir, Flumes, Electronic Devices, Rated Section, Rated Gate, Floating Devices, Dilution Method, Gauges Data Sensors, Data Logger)
- Maintenance of Irrigation Canals
- Measures Adopted to Control Silt Entry into Canals
- Silt Ejectors & Excluders
- Cross Drainage Works, Types & Functions (Aqueduct & Syphon Aqueduct, Super-passage & Canal Syphon, Level Crossing, Inlets & Outlets)

Water Logging & Salinity

- Causes & Adverse Effects of Water Logging & Salinity
- Reclamation of Water Logged Soils (Preventive & Curative Measures)
- Occurrence & Need of Drainage
- Adverse effects of Poor Drainage System
- Drainage Network in Irrigated Areas
- Types of Drainage Systems
- Introduction of Salinity Control & Reclamation Projects (SCARPs)

Canal Lining: Modern Concepts

- Canal Lining (Necessity, Suitability, Advantages & Disadvantages, Types)
- Issues related to Costs/Benefits
- Brief Review of Advanced Techniques for Canal Lining
- Measurement of Seepage Losses

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Irrigation Engineering by R.K. Sharma & T.K. Sharma, S. Chand & Company, New Delhi
- Irrigation & Water Power Engineering by Punmia B.C., Standard Publishers, Delhi
- Irrigation Engineering & Hydraulic Structures by Santosh Kumar Garg, Khanna Publishers, Dehli
- Irrigation & Hydraulic Structures (Theory, Design & Practice) by Iqbal Ali, Allied Book Company, Lahore

Irrigation Engineering

Course Outlines

- Water Resources of Pakistan
- Water Requirements of Crops; Methods of Irrigation
- Canal Irrigation System & Design of Channel
- Diversion Head Works
- Canal Flow Measurements; Uncertainty & Error
- Cross Drainage Works; Canal Regulation Works
- Canal Operation and Control
- Water Logging & Salinity; Canal Lining: Modern Concepts
- Water Management: Modern Concepts
- End Semester Exam

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Punmia B.C. , “Irrigation & Water Power Engineering”, Standard Publishers, Delhi
- Iqbal Ali, “Irrigation & Hydraulic Structures (Theory, Design & Practice)”, Allied Book Company, Lahore
- Santosh Kumar Garg, “Irrigation Engineering & Hydraulic Structures”, Khanna Publishers, Dehli
- R.K. Sharma & T.K. Sharma, “Irrigation Engineering”, S. Chand & Company, New Delhi
- Asawa G.L., “Irrigation Engineering”, New Age International Publishers
- Basak N.N., “Irrigation Engineering”, Tata McGraw-Hill Publishing Co. New Delhi
- Dilip Kumar Majumdar, “Irrigation Water Management (Principles & Practices)”, Prentice Hall of India, Ltd
- Gupta B.L. & Amir Gupta, “Irrigation Engineering”, Satya Praheshan, New Delhi
- Michael A.M., “Irrigation Theory & Practical”, Vikas Publishing Pvt Ltd
- MASSCOTE FAO 63
- UN Water and Global Water Partnership: Road mapping for advancing towards IWRM process
- Value of Virtual Water in Food: Principles and Virtues, Daniel Renault (FAO)
- Paper presented at the UNESCO-IHE Workshop on Virtual Water Trade 12-13 December 2002 Delft, the Netherlands
- Coping with water scarcity An action framework FAO Water Report no 38

- Performance Indicators of Irrigation Service, Daniel Renault & Robina Wahaj FAO NRLWr agriculture and food security
- Multiple Uses of Water Services in Large Irrigation Systems: Auditing and planning modernization The MASSMUS Approach FAO
- FAO IDP 26 Small hydraulic structures
- Masscotte Technical Modules FAO 63: Paul Ankum “Operation methods in canal irrigation delivery systems” (Extract from FAO: Irrigation Scheduling: From Theory to Practice – Proceedings – FAO Water Report 8. 1998) & Daniel Renault “Operation Techniques in Canal Systems
- Canal Systems Automation Manual. USBR Vol.1 & 2

River Engineering

Course Outlines

Introduction

- Introduction
- River Characteristics
- Use of Rivers

River Hydraulics

- Flow Classification
- Fundamental Equations
- Techniques of Hydraulic Studies
- Data Requirement for Hydraulic Studies

River Morphology

- Classification of Rivers
- Behavior of Rivers
- River Regime Theories
- Meandering and Cut offs
- Effect of Dams on River Regimes

River Survey

- Introduction
- Mapping water levels, bed levels, discharges

- Stage Discharge Relationship
- Sediments mapping
- Water Quality mapping

River Training Works and Flood Control

River Engineering

- Introduction
- Bed Regulation
- Discharge Control
- Water Level Control
- Water Quality Control
- River Engineering for Various Purposes

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Pierre Y. Julien, River Mechanics, Cambridge University Press, 2002.
- Stephen Darby (Ed) et al, Incised River Channels: Processes, Forms, Engineering and Management. John Wiley & Sons, 1999.
- Hsieh W. Shen (Ed) Modeling of Rivers, John Wiley & Sons, 1979.
- H. Chang, Fluvial Processes in River Engineering, John Wiley & Sons, 1988.
- W. H. Graf, Fluvial Hydraulics: Flow and Transport Processes in Channels of Simple
- Geometry, John Wiley & Sons, 1999
- Performance Indicators of Irrigation Service, Daniel Renault & Robina Wahaj FAO NRLWr agriculture and food security

Elective-II (Computer Sciences / Electronics Engineering)

Data Warehouse & Data Mining

Course Outlines:

- Introduction to Data Warehouse and
- Background (Organization Information Flow, Problems with Informational Systems)
- Dimensional Analysis and Information Packages (Data warehouse Development Phases, Requirement gathering)
- Dimensional Analysis: Retail Case Study
- Dimensional Modeling (Star Schema, Fact Table)
- Dimension Tables, Star Schema vs ER Model)
- Advanced Dimensional Modeling (Slowly changing dimensions, Snowflake schema, Aggregate fact tables)
- Data warehousing environment and Data Marts
- SQL Queries for Cube Operations, Online Analytical Processing (OLAP) Flavors
- Data extraction, transformation, and loading (ETL)
- Data Cleaning
- Physical DW Design and Implementation
- Introduction to Data Mining, Data Preprocessing
- Classification (Nearest Neighbor Algorithm, Decision Tree)
- Model Evaluation (Precision, Recall, Accuracy, F-measure)
- Clustering
- Guest Lectures (Advance Data mining trends)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Data Warehousing Fundamentals for IT Professionals, (2nd Edition) by P. Ponniah, 2010, Wiley.
- Data Mining: Concepts and Techniques, (3rd Edition), by J. Han, M. Kamber 2011, Morgan Kaufmann.
- The Microsoft Data warehouse Toolkit, by J. Mundy, W. Thornthwaite, 2006, Wiley.
- The Data Warehouse Toolkit (2nd Edition). By R. Kimball, M. Ross 2002, Wiley.
- The Data Warehouse Toolkit by R. Kimball, R. Merz, 2000.
- Building the Web-Enabled Data Warehouse, Wiley.
- Click stream Data Warehousing, by M. Sweiger, M. Madsen, J. Langston, H. Lombard, 2002, Wiley.
- Introductory and Advanced Topics Data Mining, by M. Dunham, 2003, Prentice-Hall.

Machine Learning

Course Outlines:

- Course Introduction, Machine Learning Overview, Supervised / Unsupervised Learning
- Decision Tree Learning
- Linear Regression with One Variable
- Linear Regression with Multiple Variables
- Logistic Regression
- Regularization
- Artificial Neural Networks
- Machine Learning System Design
- Support Vector Machines
- Instance-Based Learning
- Clustering
- Dimensionality Reduction
- Anomaly Detection
- Recommender Systems

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Pattern Recognition and Machine Learning by Christopher M. Bishop. 2007, Springer.
- Machine Learning by Tom M. Mitchell, 1997, McGraw-Hill.
- Artificial Intelligence: A Modern Approach, (3rdEdition) by Stuart Russell and Peter Norvig, Prentice Hall.

Digital Image Processing

Course Outlines

Introduction to Image Processing

- Examples and applications of image processing
- Elements of visual perception
- Image sensing and acquisition
- Image sampling and quantization

Mathematical Tools Used in Image Processing

- Neighborhood, Connectivity, Regions & Boundaries
- Distance Measures
- Image Operations on Pixel

Intensity Transformation Functions

- Image negatives, log transformations, power law transformations
- Piecewise linear and other transformations

Introduction to Histograms

- Histogram based techniques
- Convolution and correlation

Spatial Filters & Sharpening Filters

- Smoothing in spatial domain
- Sharpening in spatial domain

Image Restoration and Reconstruction

- Noise models
- Noise reduction by spatial filtering
- Noise reduction by frequency filtering

Morphological Image Processing

- Erosion and dilation
- Opening and closing
- Basic morphological algorithms

Discrete Fourier Transform

- Extension of DFT to 2D
- DFT properties

Filtering the Frequency Domain

- Image smoothing in frequency domain
- Image sharpening in frequency domain

Color Image Processing

- Color models
- Color transformations

Image Segmentation

- Point, line and edge detection
- Thresholding
- Region-based segmentation

Image Compression

- Basic image compression
- Error-Free, lossy & Image Compression Standards

Advanced Topics in Image Processing

Semester Project Presentations

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- R.C. Gonzalez and R.E. Woods, “Digital Image Processing”, 3rd Ed., Prentice-Hall 2008
- Web is the best and greenest “textbook”
- Digital Image Processing, (6th Edition) by B. Jahne, 2005, Springer.
- Digital Image Processing using MATLAB, (2nd Edition) by. R.C. Gonzalez and R.E. Wood, 2009.
- Learning OpenCV: Computer Vision with the OpenCV Library (1st Edition) by G. Bradski and A. Kaehler, 2008, O'Reilly Media.
- Computer Vision Algorithms and Applications, (1st Edition) by R. Szeliski, 2011 Springer.
- An introduction to Digital Image Processing with Matlab, (1st Edition) by A. McAndrew, 2004, Course Technology.
- Fundamentals of Digital Image Processing with practical approach (6th Edition) by C. Solomon and T. Breckon, 2011

Signals and Systems

Course Outlines

- Introduction to Signals and Systems: Types of Signals, Types of Systems
- Frequency Domain view of Signals and Systems
- Linear Time-Invariant (LTI) Systems Theory
- Fourier Series: Representation of periodic signals into sum of weighted sinusoids. Sinusoids interact with LTI systems in simple predictable ways leading to tractable modeling, analysis and design of signals and systems
- Fourier Transform: Representation of aperiodic signals into integral of weighted sinusoids. Sinusoids interact with LTI systems in simple predictable ways leading to tractable modeling, analysis and design of signals and systems.
- Laplace Transform: Representations of continuous time signals (some of which may not have a Fourier transform) as integral of scaled complex exponentials. Complex exponentials interact with LTI systems in simple predictable ways leading to tractable modeling, analysis and design of signals and systems.
- Z Transform: Representation of discrete time signals (some of which may not have a Fourier transform) as sum of scaled complex exponentials. Complex exponentials interact with LTI systems in simple predictable ways leading to tractable modeling, analysis and design of signals and systems.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Signal and Systems by Alan V. Oppenheim, Alan S. Willsky and S. Hamid
- “Linear Systems and Signals” by B P Lathi

Web Technologies

Course Outlines

Introduction to Web & Web applications

- Course Introduction, About Web: Definition, Internet Protocols (Layers),
- Client Server Model, Request Response Loop, Peer to Peer model.
- Role of DNS, HTTP, Uniform Resource Locators (URL), Web Servers

Client Side - Static content

- HTML: Syntax, Structure, Elements, Markup.
- HTML5, Role of W3C, Doc Type, HTML essentials

Client Side - Static content

- HTML Tags, nested tags, required structured tags, Doctype, Head, Divs,
- Images, Links, Lists, Tables, Nav Bar

Client Side - Styling to static content

- CSS1: Syntax, Blocks, Selectors, Properties, Inline styles, Id vs class sectors, Margins, Borders, Text, Style sheets
- CSS3: Bootstrap, Media Queries, Responsive Grid, Grid layout and use of class keyword

Client Side – Dynamic content

- Javascript: design, syntax,
- XHTML: DOM, Events
- TypeScript

Client Side – Reading and storing static content

- XML: syntax, elements, attributes, parser, DTD: schema
- JSON basics

Client Side – Dynamic content

- AJAX and JQuery: Library, syntax, scripting, functions, event actions on clicks

Client Side – Dynamic content

- AJAX and JQuery: Variables, , usages, if-else structure, logical operators

Client Side – Managing dynamic content

- Angular JS: Advantages, features

Server Side – Static content

- PHP: Server side scripting concept, introduction, syntax, control structures, Datatypes, Strings, printf,

Server Side – Content generation

- PHP: if-else, do-while, for clause, arrays, Classes and Objects
- PHP Laravel Framework

Server Side – Storing content

- MySQL: Database & Web, MySQL, stored procedures, stored functions
- PHP Laravel Frame continued

Server Side – Passing content within apps

- PHP: Session variables and JSON
- LaraVel Framework

Projects week and Advanced technologies

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- The Complete Reference, HTML & XHTML (2003), Thomas Powell
- Web Programming: Building Internet Applications (2007) 2nd, 3rd Edition by Chris Bates

- Forbes, Alan. The Joy of PHP: A Beginner's Guide to Programming Interactive Web
- Applications with PHP and MySQL (2015)
- W3Schools (<https://www.w3schools.com/>)
- PHP Homepage (<http://php.net/>)
- Stackoverflow (<https://stackoverflow.com/>)

Elective-III (Geoinformatics)

GIS Programming

Course Outlines

- Fundamentals of geo-processing, Fundamentals of Python
- Usage of variables and special datatypes, Naming conventions and reserved words
- Testing and printing variable values, Looping and control structures
- Debugging, optional and required parameters
- Objects, properties and methods, the OO paradigm
- Object Model Diagrams, The geo-processor object introduction
- Functions and parameters, passing and returning values, Multiple inputs and complex parameter passing
- Selections and sets, SQL basics, Writing results to disk, various formats and switches
- Advanced topics and further directions
- Num.py for numerical modeling
- Java Topology Suite
- Architecture of ArcObjects
- Main ArcObjects classes, classes and interfaces (IFeatureLayer, IFeatureClass, IFeature, IFeatureCursor, etc.) other useful modules

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Eric Pimpler (2013), “Programming ArcGIS 10.1 with Python Cookbook”.
- Bugg, K.E. (2003), “GIS Programming: Prepare for the Gathering Storm”, GEO World.
- Kroplin, B. (2005), “Beginning MapServer: Open Source GIS Development”, 1st Edition, A press, Co. ISBN: 1590594908
- Ralston, B. A. (2001), “Developing GIS Solutions with Map Objects and Visual Basic”, Onword Press, New York. ISBN: 0766854388
- Rigaux, P., Scholl, M. and Voisard, A. (2001), “Spatial Databases: With Application to GIS” 1st Edition, Morgan Kaufmann. ISBN: 1558605886.

Integrated Geotechnologies

Course Outlines

Human Computer Interaction

The section focuses on the history of geographic information sciences in the context of the evolution of hardware and software technologies. In the process human computer interaction evolved as a parallel discipline which herein shall be the focus too,

Human Understanding of Space

Human behavior and its understanding is paramount to the evolution and streamlining of modern day technologies. The segment shall focus on human cognitive behavior, spatial cognition and computers and how one can approach making maps more understandable.

Cartographic Theory and Principles

Cartographic design and theory has been at the heart of geospatial technologies, it is therefore necessary to talk about how software implementation of cartographic theory and principles face challenges.

Computer Meditated Communication

While working on technologies that are various and people specializing in them are from different scientific backgrounds the role of communication becomes highly critical. This section focuses on the role of computer mediate communication in the process of integrating geospatial technologies and how in today's world this has become real-time.

User-Centered Design and Usability Engineering

User has been the focus on all geospatial technology developments. Therefore, it is critical to discuss the principles of user centered design, understand user-needs and application development.

Practicalities and Technique

This section has been organized as a study of, application planning, the role of practical cartography, principles of human-computer interaction and evaluation and deployment of geospatial technologies. It uses web-mapping application and Human computer interaction as example tools.

Examples from the Field and Industry

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Interacting with geospatial technologies by Haklay, M., 2010, John Wiley.
- Integrated geospatial technologies: a guide to GPS, GIS, and data logging by Thurston, J., Moore, J. P., & Poiker, T. K., 2003, John Wiley.
- Remote sensing digital image analysis: an introduction by Richards, J. A. 2013. . Springer.
- Python geospatial development by Westra, E. 2010, Packt Publishing

- ArcGIS Developer's Guide for Visual Basic Applications (VBA) by Razavi, A. H., 2002, Delmar Learning.
- Web GIS: principles and applications by Fu, P., & Sun, J., 2010, Esri Press.

Elective-IV (Natural Resources Management)

Introduction to Environmental Engineering

Course Outlines

- Causes of Environmental Problems
- Units of Measurement
- Materials Balance
- Mathematics of Growth
- Water Pollution
- Water Treatment
- Water Treatment (Cont.)
- Wastewater Treatment
- Wastewater Treatment (Cont.)
- Sludge Treatment
- Air Pollution
- Air Pollution (Cont.)
- Air Pollution (Cont.)
- Solid Waste management
- Solid Waste management (Cont.)
- Disposal by Sanitary Landfill
- Hazardous Waste Management
- Hazardous Waste Management (Cont.)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Introduction to Environmental Engineering and Science by Gilbert M. Masters and Wendell P. Ela (Third Edition, 2008)
- Principles of Environmental Engineering & Science by Mackenzie Davis and Susan Masten (Second Edition, 2008)
- Environmental engineering by J. Jeffrey Peirce and P. AarneVesilind (Fourth Edition, 2003)

Water Supply and Waste Water Engineering

Course Outlines

PART – I **Water Supply**

Sources of Water Supply Types,

- Types of well construction
- Yield of well, Test for yield of well etc.

Water Quantity and Population Forecast

- Forecasting population
- Consumption for various purposes.
- Factors affecting consumption, Size of city, Characteristics of population, Industries and Commerce.
- Climatic conditions. Metering. Variation in rates of consumption. Fire demand. Density of population. Zoning.

Water Quality

- Water impurities & their health significances. Waterborne diseases.
- Soluble mineral and gaseous impurities.
- Water treatment plant.
- Treatment of Water.

Collection, Conveyance and Distribution of Water

- Intake, Types of intakes.
- Methods of distribution.
- Layout and design of water distribution systems.
- Rising Mains, Service reservoirs (overhead and underground), Storage Capacity, Fixtures and their installation.
- Hydrant placement, valve placement.
- Location of pipe leakage.
- Flow in pipes. Tapping of water mains

Water Supply Sampling, Testing and Treatment

- Water pollutants and waterborne diseases
- Sampling techniques and examination of water (physical, chemical and microbiological parameters).
- Treatment of surface & ground water, screening, sedimentation, coagulation, filtration, Water disinfections and chemicals:
- Use of chlorine, quantity, dosage & efficiency.
- Emergency treatment methods.

Pumps and Pumping Stations

- Centrifugal Pumps and its characteristics.
- Pump selection.
- Location of pumping stations.

PART – II Waste Water Engineering

Introduction of Wastewater Collection System

- Basic definitions and terms
- Components of wastewater collection system
- Types of wastewater collection systems

Design of Wastewater Collection System

- Sewer systems, the survey and map layout of the system.
- Sewer appurtenances
- Hydraulics of sewers
- Design of sanitary and storm sewers

- Loads on sewers
- Sewer pipes and beddings

Waste water Treatment System- Septic Tank

- Principles of septic tank
- Uses of septic tank
- Leachfield
- Design of septic tank
- Soakage Well

Waste Stabilization Pond (WSP)

- Principles of WSP
- Types of WSP
- Arrangement of WSP
- Design of WSP

Sludge Management

- Sludge management techniques
- Design of drying beds

Sewage Disposal Plant

- Design
- Siting criteria
- Disposal techniques.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Water Supply and Sewerage (6th Edition) by E.W. Steel and Terence J. McGhee, McGraw Hill Book Company.

- Wastewater Treatment for Pollution Control and Reuse, (3rd Edition) by Arceivala
- T. Environmental Engineering by Peavey. H.S. RR & George
- Water supply & Sanitary Engineering by KulKarni.

Elements of Weather

Course Outlines

- Introduction, Weather info
- Weather information and maps
- Atmosphere
- Atmospheric circulation
- Air pressure
- Humidity, Clouds, precipitation
- Wind, Planetary circulations
- Local Winds and Monsoons
- El Niño / Southern Oscillation Events
- Climate Change/Global Warming
- Satellite remote sensing for studies of e.g. temperature, composition, aerosol and cloud properties, precipitation, as well as the properties of sea surface and sea ice
- Satellite Applications: Weather Forecasting

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- A World of Weather: Fundamentals of Meteorology by Nese Jon M and Grenci Lee M in 2011. ISBN-13: 978-0757594267

- Remote sensing of the atmosphere and clouds (1stEdition) by Bellingham, WA: SPIE.
- Spatial interpolation for climate data. (1stEdition) by Tsay, S. 2006. Dobesch, H., P. Dumolard& I. Dyras 2007. London: ISTE.
- Satellite rainfall applications for surface hydrology. (1st Edition) By Gebremichael, M. & F. Hossain 2010. Dordrecht: Springer.

Environmental Impact Assessment

Course Outlines

- Introduction to Environment and EIA
- Principles and purposes of IEE and EIA and its significance for the society
- Cost and benefit of EIA
- Main stages in EIA process
- Public consultation and participation in EIA process
- EIA methods and techniques for impact prediction and evaluation
- EIA involvement during project life cycle
- EIA review and post project analysis
- EIA process management
- Role of quality assurance and quality control in environmental analysis
- EIA regulations 2000 of Pakistan, and IEE/EIA guidelines

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- GIS and Remote Sensing Integrated Environmental Impact Assessment in Irrigation Development: A case study on Fincha Valley/Ethiopia Ahmed Amdihun,2009, ISBN-10: 3639167546

- Environmental Modelling with GIS and Remote Sensing by Andrew Skidmore.
- Expert Systems and Geographic Information Systems for Impact Assessment (1st Edition) by Agustin Rodriguez-Bachiller and John Glasson.
- Environmental Impact Assessment Methodologies by Y. Anjaneyulu, Valli Manickam, 2011

Renewable Energy Resource

Course Outline

- **Energy and its Types**
 - Thermal Energy
 - Chemical Energy
 - Electromagnetic Energy
 - Nuclear Energy
 - Mechanical Energy
- Energy conservation, Energy Efficiency and Energy Pyramid
- Conventional and Renewable Energy Resources
- Energy Mix of the world (why Renewable energy is the need of time?)
- Energy Mix of Pakistan and its Details
- Fossil Energy Resources and Technologies
- Renewable Energy Resources
 - Types of Renewable Energies
 - Solar Energy (thermal and photovoltaics)
 - Wind Energy (resources, turbines and applications)
 - Hydropower (resources, turbines, small hydro power systems and applications)
 - Biomass Energy (resources, thermal and non-thermal applications of biomass, and biofuels)
 - Geothermal Energy (resources, heat and electricity applications)
 - Other Renewable Energy Resources (Tidal, Wave and Ocean Thermal Energy Conversion)
 - Renewable Energy and Climate Change
- Greenhouse Gases and Climate Change
- Energy Use and the Greenhouse Effect

- Greenhouse Gases: Types and Sources
- Climate Change Impacts
- Technology Options for GHG Emission Mitigation
- Renewable Energy
- Energy Efficient Technologies by Sector AND End-Use
- Cleaner Production
- International Climate Change Conventions, Protocols and Perspectives
- Developing vs. Developed Country Perspectives on GHG Mitigation
- United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Parties
- The Kyoto Protocol and Flexible Mechanisms: Clean Development Mechanism (CDM), Emission Trading.
- Joint Implementation

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Fundamentals of Renewable Energy Processes, (3rd Edition) by Aldo V. da Rosa
- Renewable Energy, (4th Edition) by Bent Sorensen, Physics, Engineering, Environmental Impacts, Economics & Planning

Elective-V (Land Use Planning)

Introduction to Urban and Transportation Planning

Course Outlines

Introduction to Transportation Systems & Transportation Planning Process

- Introduction to Transportation Systems
- Transportation Surveys
- Types of Planning
- Transportation Studies

Collection of Existing Travel Data (Study Area)

- Zoning and Zone Coding
- Defining Network

Origin Destination Survey Methods

- Roadside Interview Surveys
- Post Card Surveys
- Registration Number Surveys
- Tag or Sticker Surveys
- Home Interview Surveys
- Parking surveys
- Other surveys

Origin Destination Survey Systems

- Census Points
- Evaluation of Survey Accuracy
- Representation of Data
- Survey Data Analysis
- Interconnected Process of Model Building

Travel Demand Forecasting - Trip Generation

- GA and OD
- Regression Analysis
- Category Analysis

Travel Demand Forecasting - Trip Distribution Growth

- Constant Factor Method
- Average Factor Method
- Frater Method
- Furness Distribution Mathematical Models
- Gravity Model
- Intervening Opportunity Model
- Competing Opportunity Model

Travel Demand Forecasting - Modal Split

- Approaches of Modal Split
- Variables in Modal Split Models
- Diverting Private Car Trips to Public Mode Trips Certain Modal Split Techniques in Models
- Travel Time Ratio
- Travel Cost Ratio
- Regression Analysis
- Discriminate Analysis Stages of Modal Split
- Modal Split as a Part of Trip Generation

Travel Demand Forecasting - Traffic Assignment

- Desire Assignment
- Multiple Route Assignment
- Multi-Level Traffic Assignment
- Capacity Restrained Traffic Assignment
- Choice of Assignment Techniques

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Guest speaker, Industrial / Field visits, Group discussion, Report Writing.

Assessment

Assignments, Quizzes, Two One hour tests, Final Exam and Presentations.

Suggested Books:

- Transportation Planning Handbook by Micheal D. Meyer, 4th edition, July 5, 2016, ISBN: 9781118762356
- Urban Transportation Planning 2nd edition by Michael Meyer & Eric Miller.
- Urban Transportation: Planning, Operation and Management September 25, 2012, by Dr D. Johnson Victor & Dr. S Ponnuswamy.
- Modeling Transport 4th edition, by Juan de Dicos Ortuzar & Luis G. William, ISBN: 9780470760390

Fundamentals of Urban Planning

Course Outlines

Introduction to the Course- Basic Planning Concepts

Definition, Aims and Scope of planning, Description of Societal Changes, New urbanism

Socioeconomic Aspects of Planning

Summary of elements of urban structure - Networks, Buildings, Open spaces etc.
The form of the modern city in the age of automobile - Inner city & Suburban area

Approaches to Planning

Overview about Industrial revolution, transition to the industrial city and paradigm shift to systems views of planning approach from comprehensive planning approaches

Principles of planning and Planning Tools and Surveys

An introduction to basic planning principles and tools, i.e. participatory approach and related surveys, i.e., land use survey, density survey, demographic surveys etc.

Current State, Challenges and Issues

General discussion on the current condition of cities and regions and the challenges and issues they are facing today in the form of Slums, katchi abadies issues of inner city.

Urban Renewal, Urban Regeneration

Squatter settlement & slums up gradation, and re-planning the existing towns and cities

Overview of Urban and Regional Planning Theories and Issues

Introduction to essential planning theories such as Location Theory, Concentric Zone Theory, Multiple-Nuclei Theory, Sector Theory, Central Place Theory, Growth Pole Theory, etc.

Street Patterns – Different Concepts

Layouts and location of various sectors in a city i.e., residential, commercial, grid iron pattern etc.

Sustainable Development – Concepts and Dimensions

Introduction to sustainable urban development, its social economic and environmental aspects and means to achieve sustainable urban development.

The Preparation of the Plan (Master/structure Plan)

Description of various stages involve in physical planning process and the relation between surveys and plan.

GIS application in Urban Planning

Describe how urban planners typically use GIS as a tool for analysis and the display of quantitative data to solve urban planning problems.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Broddbent. G.J.C. Anthony, Emerging Concept in Urban Space Design, Van Nostrand Reinhold Co. Ltd.

- Snyter. J.C. Introduction to Urban Planning, Milwaukee McGraw Hill Book Co.
- Principles and Practice of Town and Country Planning by Lewis Keeble
- Transportation Engineering and Planning – C S Papa Costas & P D Prevedours (3rd Edition)

Land Information System

Course Outlines

- Introduction to Land Information System
- Introduction to Land and Land Administration
- Cadastre: Types and Role in Land Administration
- Land Registration Systems; Property Rights and Adverse Possessions
- Land Registration process, Land Valuation and Land adjudication
- Cadastral Boundaries; Cadastral Surveying and Digital Mapping
- Methods of Data Collection, Data Refinement, Data Storage
- Procedures for Introducing a Land Information / Administration System
- Identifying issues in ArcGIS for Land Records
- National Spatial Data Infrastructure and their Spatial Hierarchy
- The Case Studies of LIS in Developed Countries

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Land Information Management, by Peter F. Dale, John D. McLaughlin, 1998, Oxford University Press, ISBN: 0198584040
- GIS and Land Records by Nancy Von Meyer, 2004, ESRI Press, ISBN: 1589480775

- Land Administration Guidelines: with special reference to countries in transition by Enschede, the Netherlands. United Nations 1996, New York & Geneva.
- GIS in Land and Property Management by Peter Wyatt, Martin P. Ralphs, 2003, Spon Press, ISBN: 0415240654

Elective-VI (Special Topics)

Special Topic in GIS

Special Topic in RS

Integrated Modelling for Resource Management

Elective-VII (Inter-Disciplinary)

Construction Project Management

Course Outlines

Introduction

- What is project?
- What is project management?
- Relationship to other management disciplines.

The Project Management Context

- Project phases and the project life cycle.
- Project stakeholders.
- Organizational influences.
- Key management skills.

Project Management Processes

- Project processes.
- Process groups.
- Process interactions project evaluation & review technique (PERT).

Project Integration Management

- Project plan development.
- Project plan execution.
- Integrated change control.

Project Scope Management

- Initiation.
- Scope planning.
- Scope definition.
- Scope verification.
- Scope change control.

Project time Management

- Activity definition.
- Activity sequencing.
- Activity duration estimating.
- Schedule development.
- Schedule control.

Project Cost Management

- Resource planning.
- Cost estimating.
- Cost budgeting.
- Cost control.

Project Quality Management

- Quality planning.
- Quality assurance.
- Quality control.

Project Human Resource Management

- Organizational planning.
- Staff acquisition.
- Team development.

Project Communication Management

- Communication planning.
- Information distribution.
- Performance reporting.
- Administrative closure.

Project Procurement Management

- Procurement planning.
- Solicitation planning.
- Solicitation.
- Source selection.
- Contract administration.
- Contract closeout.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Project Management a Managerial Approach (7th Edition) by Kack R Meredith, 2010.
- Project Management for Engineers and Construction (2ndEdition) by G.D. Oberlender, 2000. ISBN: 0070393605
- Project Management: A Systems Approach to Planning, Scheduling, and Controlling (10thEdition) by Harold Kerzner, 2009. ISBN: 0470278706
- Construction Project Management (5thEdition) by Richard H. Clough, 2008. ISBN: 047174588X

Engineering Geology

Course Outlines

- The Earth: Surface, Structure and Age, The Surface and interior of earth.
- Geological Structures: Structural Features, Dip, Strike, Folds, Faults, joints, unconformities, conformable and un-conformable series of strata. Effects of folding, faulting and jointing in civil engineering projects, and their recognition in the field.
- In-situ Investigations: Components, Desk Study, Field Reconnaissance, Field Investigations, Construction Records. Laboratory Investigations: Samples and Sampling, Laboratory Tests.
- Earthquakes, definitions, technical terms, causes of earthquake, classification of earthquakes, earthquake or seismic waves, mechanism of earthquake, Measuring of earthquake intensity (Modified Mercalli Intensity Scale), effects of earthquake & protective measures against earthquake.
- Volcanoes, formation of volcanoes, causes of volcanoes, nature and types of volcanic eruptions, products of eruptions, types of volcanoes, geysers.
- Landslides, definitions, causes of landslides, classification of landslides, preventive measures against landslides.
- Geological Survey, physical method of subsurface mapping, exploratory geological surveys at engineering sites.
- Tunneling, engineering geology of tunnels, geological survey prior to tunneling, lining of tunnels and their section, selection of tunnel site and its requirements.
- Engineering Applications
 - Importance of geology for civil engineering projects,
 - Important building stones and other construction materials.
 - Geology of aquifers, wells, springs, streams and ground water conditions, hydrologic cycle.
- Role of geology in selection of sites for dams, reservoirs and pertinent geological investigations.
- Geology of foundations, cutting tunnels, Highways, Airfields and bridges.
- Field Visits.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Structural Geology (3rdEdition) by Billings Marland P., 2006. ISBN: 8120300599.
- Essentials of Geology (with Geology NOW), (4thEdition) by Reed Wicander, James S. Monroe, 2005. ISBN: 049501365X
- Engineering Geology by W. Henry Penning, 2011. ISBN: 111643489X
- Principles of Engineering Geology by K.V.G.K. Gokhale, 2005.

Occupational Health and Safety

Course Description:

This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

- i. Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.
- ii. Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
- iii. Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the Ontario Occupational Health and Safety Regulations as well as supported legislation.

- iv. Demonstrate a comprehension of the changes created by WHMIS and OSHA legislation in everyday life.

Course Outline:

Health and Safety Foundations

- a. Nature and scope of health and safety
- b. Reasons/benefits and barriers for good practices of health and safety
- c. Legal frame work and OHS Management System

Fostering a Safety Culture

- a. Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
- b. Re-thinking safety-learning from incidents
- c. Safety ethics and rules
- d. Roles and responsibilities towards safety
- e. Building positive attitude towards safety
- f. Safety cultures in academic institutions

Recognizing and Communicating Hazards

- a. Hazards and Risk
- b. Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.
- c. Learning the language of safety: Signs, symbols and labels

Finding Hazard Information

- a. Material safety data sheets
- b. Safety data sheets and the GHS (Globally Harmonized Systems)

Accidents & Their Effect on Industry

- a. Costs of accidents
- b. Time lost
- c. Work injuries, parts of the body injured on the job
- d. Chemical burn injuries
- e. Construction injuries
- f. Fire injuries

Assessing and Minimizing the Risks from Hazards

- a. Risk Concept and Terminology
- b. Risk assessment procedure
- c. Risk Metric's
- d. Risk Estimation and Acceptability Criteria
- e. Principles of risk prevention
- f. Selection and implementation of appropriate Risk controls
- g. Hierarchy of controls

Preparing for Emergency Response Procedures

- a. Fire
- b. Chemical Spill
- c. First Aid
- d. Safety Drills / Trainings:
 - Firefighting
 - Evacuation in case of emergency

Stress and Safety at Work environment

- a. Workplace stress and sources
- b. Human reaction to workplace stress
- c. Measurement of workplace stress
- d. Shift work, stress and safety
- e. Improving safety by reducing stress
- f. Stress in safety managers
- g. Stress and workers compensation

Incident Investigation

- a. Importance of investigation
- b. Recording and reporting
- c. Techniques of investigation
- d. Monitoring
- e. Review
- f. Auditing Health and Safety

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignment, project report, quizzes, end-semester exam

Suggested Books:

- The A-Z of health and safety by Jeremy Stranks, 2006.
- The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
- Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

12.2 Non-Engineering Domain

Earth Sciences

Geography

Outlines

- Geography, neo-geography, digital cartography and GIS
- Earth's rotation and insolation
- Global energy balance
- Air, temperature and global circulation
- Moisture and precipitation, Weather systems and global climate
- Bio-geography
- Global warning and environmental sustainability
- Geography of South Asia
- Landscape and people of South Asia
- Global economy, World population
- Factors affecting population distribution
- Relationship between man and his environment

Field Visits:

Field Trip

- Trail 6: Margalla Hills (Bio-Geography)
- Population Census Organization

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Strahler, A. H., & Strahler, A. N. (2010). Physical geography. Wiley.
- Fouberg, Erin H., and Alexander B. Murphy. Human geography: people, place, and culture. Wiley, 2009.
- Petersen, James F., Dorothy Sack, and Robert E. Gabler. Fundamentals of physical geography. Brooks/Cole Publishing Company, 2010.
- Dahlman, Carl T., William H. Renwick, and Edward F. Bergman. Introduction to Geography: People, Places, and Environment. Prentice Hall, 2011.

Geosciences

Outlines:

- Introduction to Geosciences
- Geologic Time, Evolution and Fossils
- Water, Deserts and Winds
- Erosions and landslide
- Glaciers and Climate. RS application in glaciers and climate
- Rocks and Minerals
- Tools and techniques used for identification of rocks and minerals (field visit to GARL)
- Introduction to Hyperspectral remote sensing, Geology perspective
- Geology of Pakistan
- Geological Survey
- Geological Mapping using GIT's, Latest trends
- Mountain Belts and Continental Crust

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. Disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam

Suggested Books:

- Physical Geology (14th Edition) by Charles C. Plummer, Diane Carlson, Lisa Hemmersley, 2012. ISBN-10:0073369381, ISBN-13:978-0073369389.
- Jensen, J. R. (2009). Remote sensing of the environment: An earth resource perspective 2/e. Pearson Education India.
- Prost, G. L. (2002). Remote sensing for geologists: a guide to image interpretation. CRC Press.
- Earth: An Introduction to Physical Geology, (11th Edition) by Edward J. Tarbuck, Frederick Lutgens, Dennis Tasa, 2013, ISBN-10: 00321814061, ISBN-13: 978-0321814067.
- Essentials of Geology, (11th Edition) by Frederick K. Lutgens, Edward J. Tarbuck, Dennis Tasa, 2011, ISBN-10: 0321714725, ISBN-13: 978-0321714725.
- Basic Geological Mapping by Richard J. Lisle, Peter Brabham, John W. Barnes, 2011.
- Laboratory Manual in Physical Geology, (9th Edition) by Richard M. Busch, 2011, ISBN-10: 0321689577 | ISBN-13: 978-0321689573 Prentice Hall.
- Geological Field Techniques by Angela L. Coe (editor), 2010, Wiley-Blackwell.

English Courses

Functional English

Area Scope:

The knowledge units in this area collectively encompass the following:

- Follow English vocabulary and skills to use it in professional life.
- Identify common errors usually made by the Learners of English as second language
- Practice English correctly in speaking and writing

Course Outlines:

- Public Speaking

- The Art of Creating a Power Point Presentation.
- Interacting with the Opposite Gender
- Classroom Etiquettes and Teachers' Expectations
- Articles
- Prepositions
- Homophones
- Punctuation
- Tenses in English Grammar
- Formal Letter Writing
- Summary writing
- Organizing and planning your writing
- Sensory Perception in writing.
- Critical thinking
- Final Term Project

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- P. C. Wren & H. Martin "High School English Grammar & Composition".
- Colin W. Davis & Andrew J. Watts New Expressway for English 1 (New Edition)
- Herta A. Murphy & Herbert William Hildebrandt. Effective Business Communications
- Diana Hacker. A Writer's Reference
- Sadat Ali Shah. Exploring the World of English
- J. Thomson and A. V. Martinet. Practical English Grammar, "University Physics", 13th Edition

Communication Skills

Area Scope:

The knowledge units in this area collectively encompass the following:

- Communicate effectively using intermediate- to-advanced level English while developing the understanding of essentials of communication skills.
- Participate in group discussions by attentive listening, questioning to clarify ideas, eliciting responses, or disagreeing in a constructive way.

Course Outlines:

By the end of the semester students will have skills including:

Writing Skills

- Vocabulary Building
- Writing Skills: Essays and Letters
- Common Writing Errors
- Purposeful Writing

Reading Skills

- Skimming and Scanning
- Critical Reading
- Reading for Understanding
- Techniques and strategies to develop sound vocabulary.

Listening Skills

- Introduction to Communication Process
- Seven Cs of Communication
- Types of Listening
- Listening for Comprehension

Speaking Skills

- Verbal and Non-Verbal Communication
- Basics of Presentation Skills
- Presentation Strategies and public speaking skills.
- Use of Audio-Visual Aids
- Basics of Group Communication

- Listening Skills
- Communicate effectively in job interviews.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Anchor in English-II (Lessons 1-5), A SPELT Publication
- Christopher Fry, “Summary Writing (Book-I)”, Oxford University Press
- College Essays by John Langland
- Barron’s TOEFL iBT Edition
- Communication Skills for Engineers by Sunita Marshal and C. Muralikrishna

Technical Writing and Presentation Skills

Area Scope:

The knowledge units in this area collectively encompass the following:

- The students will be able to write technically correct statements, assignments, final year project report, project proposal, short report and research paper
- The students would be able to their write CV, cover letter and business/ professional Correspondence meeting all criteria
- The students would be able to present their work/ research at a technical forum.

Course Outlines:

- Introduction to Technical writing

- Proposal write-up and improvement strategies Introduction to research and research types choosing research problems and research advisors How to carry out research
- Formulation – Problem statement, Literature
- Review
- Design - Methodology
- Analysis - Data analysis and interpretation Good writing style techniques
- Uses of correct words
- Presenting and publishing research
- Write business/professional correspondence, cover letter and CV
- Writing meeting minutes

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Writing for Computer science by Justin Zobel Research Methodologies – A step by step guide for beginners, Ranjit Kumar.

Mathematics Courses

Linear Algebra

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend basic concepts of Linear Algebra and optimization
- To apply techniques of Linear Algebra and optimization for solution of engineering problems

Course Outline:

System of Linear Equations and Applications

- Overview of linear system of equations, Cases of unique solution, No solution and infinite solutions,
- Echelon form, Gauss elimination method, Inversion of matrix in the context of solution of system of equations, LU factorization, Row space and column space
- Relevant engineering case studies such as Network analysis, Traffic Flows, Balancing chemical reaction, Leontief Input-output model, Finding max stress in compound cylinder, Applications of linear systems in force balancing of structures, Markov process

Vector Spaces and Transformations

- Vector Spaces: Real vector spaces, Subspaces, Basis and dimension, Rank, Nullity
- Gram-Schmidt process for finding orthonormal basis
- Linear Transformation, Kernel of Transformation, Range of Transformation, Matrix of Transformation,
- Applications: Cryptography, Coding and decoding, Breaking of codes, Robotic Applications of linear transformations

Eigenvalues and Eigen Vectors

- Eigenvalues, Eigenvectors, Similar matrices, Diagonalization,
- Quadratic forms, Positive definite Matrices, Singular Value Decomposition, Inner product Spaces
- Applications of linear Algebra: Constructing curves and surfaces, Computer graphics, Genetics

Linear Programming

- Solution Introduction to linear programming, Optimization, Graphical method, Simplex method, Optimization problems in engineering and economics
- Dual simplex methods, Duality theory, Primal and dual problems, transportation models, north-west corner, least-cost and Vogel's approximations methods,

- Assignment model, the transshipment model and other relevant engineering case studies

Application of Linear Algebra in Dynamical Systems

- Numerical System of linear ODEs, Eigenvalue problems, Homogeneous and nonhomogeneous system of ODE.
- Dynamical systems, Population dynamics, Prey-Predator models, Stability analysis

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Book:

- Introductory Linear Algebra: By Bernard Kolman and David R. Hill, Latest Edition.
- Elementary Linear Algebra: By Howard Anton and Chris Rorres, Latest Edition.

Calculus and Analytical Geometry

Area Scope:

- To develop a clear understanding of fundamental concepts of single variable calculus
- To apply concepts of differentiation and integration to solve complex engineering problems

Course Outline:

Analytical Geometry:

- Review of vectors, scalars and vector products.

- Three dimensional coordinate system and equation of straight line and plane

Functions Limit and Continuity:

- Review of functions and graphs,
- Limits & Continuity,
- Techniques of Finding Limits,
- Discontinuity,
- Limits of Sine and Cosine and Exponential Functions

Differentiation:

- Introduction to Derivatives
- Examples of Derivatives
- Derivative as Rate of Change
- Derivative's Rules
- Implicit Differentiation
- Higher order derivatives
- Leibnitz Theorem

Applications of Derivatives:

- Applications of Derivatives
- Monotonic functions
- Optimization problems
- Relative and Absolute extrema
- First and second derivative tests
- Point of inflection
- Concavity
- Curvature
- Indeterminate Forms and L' Hospital rule
- Differentials

Integration:

- Integrals and Properties of Integrals
- Techniques of Integration
- Integration by Parts
- Definite Integrals

- Integration of Trigonometric
- Exponential and Inverse Functions
- Integration by Partial Fractions
- Reduction Rules

Applications of Integration:

- Applications of Integration
- Area under the curve
- Area between curves
- Solids of Revolution
- Volume of Solids of revolution by disk washer, Cylindrical shell & Cross Section Methods
- Center of Pressure and Depth of Center of Pressure
- Center of mass
- Arc length

Improper Integrals:

- Improper Integral
- Integrals and Singularities
- Convergence of improper integrals

Infinite Sequence and Series:

- Sequence and Infinite Series
- Convergence and Divergence of sequences and series
- Positive Term Series
- Integral Test
- Basic Comparison Test
- Limit Comparison Test
- Ratio and Root tests
- Alternating series
- Absolute and Conditional Convergence

Power and Taylor Series:

- Power series
- Maclaurin and Taylor Series and its Applications

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.
- Swokowski, Onlinick & Pence: Calculus
- Robert T. Smith & Roland B. Minton: Calculus
- Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA.

Differential Equations

Area Scope:

The knowledge units in this area collectively encompass the following:

- To define basic mathematical concepts related to differential equations
- To describe different types of analytical methods for solution of differential equations
- To formulate different engineering problems in the form of differential equations

Course Outline:

Basic Concepts and Modeling

- Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems, Degree and order of ODEs
- Formulation of first-order ODEs: Case studies related to finding age of fossils, Mixing problems and free fall motion, finding temperature of a building, RL, RC circuits, Airplane take-off problem, Population dynamics and logistic equations etc.

Analytical Methods of Solution for First-order ODEs

- Variable separable method, Reduction to variable separable form, Homogeneous equations, Differential equations reducible to homogeneous form, Solution of the related ODE models by these methods
- Exact equations, Integrating factors, Linear equations and related examples, Bernoulli's equations, Orthogonal trajectories and solution of the related ODE models by these methods

Mathematical Models Based on Second-order ODEs

- Formulation of a single RLC circuit, Spring mass systems, Earthquake model of a single story building
- Bungee Jumper model, Bridge collapse problem etc.

Analytical Methods of Solution for Second-order ODEs

- Homogeneous linear ODEs, Method of reduction order, Wronskian determinant to check independence of the solution, and related examples
- Cauchy-Euler equations and related examples, Non-homogeneous linear ODEs, Method of undetermined coefficients
- Method of variation of parameters and related example
- Analytical solution of the related ODE models by these methods

Series Solution for Second-order ODEs

- Series solution of ODEs and convergence tests
- Series solution of Legendre equation, Frobenious method of solution for Bessel equation and related applications

Laplace Transform

- Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, First shift theorem
- Laplace transform of integrals and derivative, Solution of second order ODEs by Laplace Transform, Unit step function and its Laplace transform, Second shift theorem, Convolution
- Application of Laplace transform to a system of ODEs and related applications

Partial Differential Equations

- Partial Differential Equations and their types, Applications of partial differential equations in Engineering
- Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM
- Method of Separation of Variables Method (MSVM) and solution of heat equation by the MSVM

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Advanced Engineering Mathematics by Erwin Kreyzig, John Wiley & Sons Inc. Latest Edition.
- Differential Equation with Boundary Value problems by D. G. Zill, M. R Cullen Latest Edition, Brooks/Cole Publishers.
- A First Course on Differential Equations with Modelling Applications by D. G. Zill, Latest Edition, Brooks/Cole Publishers.
- An Introduction to Mathematical Modelling by Bender, E.A., Latest Edition, Wiley, New York.

Numerical Analysis

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations

- To apply the numerical techniques to different linear and nonlinear engineering problems

Course Outline

Error Analysis and Interpolation

- Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Computer arithmetic, Condition number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and double precision
- Interpolation: Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange's interpolation, Error in interpolation, linear least square approximation, Interpolation versus least square approximation, relevant engineering case studies

Numerical Differentiation and Integration

- Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five point's formulas along with its application in engineering, relevant case studies
- Numerical integration: Trapezoidal rule, Simpson's rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, relevant case studies

Methods of solution a system of Linear Equations

- Solution of system of linear algebraic equations, Gauss elimination method
- LU factorization, Tridiagonal solver
- Applications of these methods in engineering disciplines, relevant case studies

Iterative Methods for Linear and Nonlinear Equations

- Numerical Solution of nonlinear equations: Bisection method, Newton's method, Secant method, Convergence analysis of these methods
- Newton's method for system of nonlinear equations

- Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines, relevant case studies

Numerical Methods for IVPs and BVPs

- Euler's method and its variations, Taylor's higher order methods, Error analysis, Consistency, stability and convergence
- Runge-Kutta methods of order 2, 3, and 4, Stiff ODEs, Consistency, stability and convergence
- Linear multistep methods, Numerical solution of system of ODEs
- Numerical solution of BVPs by Finite Difference Method
- Applications in engineering: Some relevant case studies

Numerical Methods for Computing Eigenvalues

- Eigenvalues and Eigenvectors of matrix: power method,
- Inverse power method, Shifted inverse power method.
- Applications of eigenvalues in engineering disciplines.

Numerical Optimization

- Unconstrained Optimization,
- Golden search ratio, Lagrange Multipliers,
- Method of steepest descent
- Applications of optimization in engineering disciplines

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Numerical Analysis: By Richard L. Burden, J. Douglas Faires, Latest Edition
- Numerical methods for scientist and engineers by R.W. Hamming (Latest Edition)
- Numerical methods for Engineers by Steven C. Chapra and R. P. Canale (Latest Edition)

Probability & Statistics

Area Scope:

The knowledge units in this area collectively encompass the following:

- To understand the basic concept of Statistics and Probability and their need in engineering.
- To Describe properties and classifications of probability density functions, regression analysis and interval estimation
- To Apply different probability and statistics techniques in engineering problems

Course Outline

Basic Statistics

- Statistics, Branches of Statistics, Importance of statistics, population, sample, observation, variables, measurement of variable, Data, primary data, secondary data

Data Presentation

- Frequency distribution (grouped, ungrouped), stem and leaf display, histogram, frequency polygon, cumulative frequency polygon, Simple & Multiple Bar diagrams

Measure of Central Tendency

- Arithmetic Mean (A.M), Geometric Mean (G.M), Harmonic Mean (H.M), Quantiles (Median, Quartiles, Deciles, Percentiles), Mode, Applications of Averages

Measure of Dispersion

- Background, Range, Quartile deviation, Mean deviation, Variance, Standard deviation, Coefficient of variation, Moments, Moments ratios, Skewness, Kurtosis
- Applications in different Engineering Disciplines

Simple Regression, Correlation and Curve Fitting

- Introduction to regression theory, Simple linear regression line, Line fitting by least square methods, Coefficient of determination,
- Simple correlation, coefficient of correlation, fitting of a first and second degree curve, fitting of exponential and logarithmic Curves, related problems.
- Principle of least squares.

Probability and Random Variables

- Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events.
- Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation,
- Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function

Probability Distributions

- Discrete distributions:
- Bernoulli distribution, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson distribution, Properties and application of these distributions.
- Continuous Distributions: Uniform Distribution, Exponential distribution, Normal distribution, Applications

Sampling and Sampling Distributions

- Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors,

- Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem.
- Applications in relevant engineering discipline

Statistical Inference and Testing of Hypothesis

- Introduction to inferential statistics, Estimation, hypothesis testing of population mean, proportion,
- Variance, Applications in Engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introduction to Statistical theory part 1, by Sher Muhammad Chaudary (Latest Edition)
- Advanced Engineering Mathematics, by Erwin Kreyszig (Latest Edition)
- Probability and Statistics for Engineers and Scientists, by Antony Hayter.
- Elementary Statistics, by Bluman.

Complex Variables & Transforms

Area Scope:

The knowledge units in this area collectively encompass the following:

- Explain the concept of complex number system, complex function, limit, continuity, differentiability and integral of complex valued functions
- Utilize the theory of complex integration and power series (Taylor series. Laurent series) to solve problems from the area of residue calculus
- Apply various transforms to solve complex integration.

Course Outline

Introduction:

- Review of complex numbers, Complex valued functions, Elementary functions (exponential and logarithmic functions, Trigonometric and hyperbolic functions and theirs inverses),
- Limits and continuity,
- Applications in Engineering

Complex Differentiation and Integration:

- Derivatives of complex valued functions, Differentiability,
- Analyticity, Cauchy Riemann Equations, Harmonic Functions,
- Complex integrals, Cauchy-Goursat Theorem, Independence of Path, Cauchy's Integral Formulas and Their Consequences, Applications

Power Series:

- Taylor Series, Laurent Series, Singularities, Zeros and poles, Residue integration method, Residue theorem,
- Conformal mapping

Laplace Transformation:

- Linearity, Scaling, First shifting theorem, Heaviside's Shifting theorem,
- Inverse Laplace transformation, Properties of inverse Laplace,
- Convolution theorem, Applications in relevant engineering discipline

Special functions and Fourier Transforms:

- (Gamma, Beta functions, Periodic functions, Error function),
- Fourier Series, Fourier Sine and Cosine series,
- Fourier transform, Fourier cosine and sine transform, properties.
- Applications in relevant engineering discipline

Z-Transformation:

- Z-transform, Properties of Z-transform, linearity and scaling, Standard Z-transform, Inverse Z-transform,
- Inverse Z- transform by using residue, convolution theorem of Z-transform,
- Formation of difference equation and its solution using Z-transform.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Advanced Engineering Mathematics, by Erwin Kreyszing, Latest Edition
- Complex Variables and Applications by Churchill, Latest Edition
- R. J. Beerends, Fourier and Laplace Transform, Cambridge University Press, Latest Edition.
- Jeffry A, Advanced Engineering Mathematics, Elsevier, Latest Edition

Multivariate Calculus

Area Scope:

The knowledge units in this area collectively encompass the following:

- To develop a clear understanding of fundamental concepts of multivariable variable calculus
- To describe of the concept of gradient, multiple integrals in rectangular, polar, cylindrical and spherical coordinates, directional derivatives, and optimization problems
- To apply the concepts line integrals, surface integrals, volume integrals, Green's, Stokes', Gauss theorems to different engineering problems

Course Outline:

Geometry of Space:

Analytical Space Geometry, Cylindrical and Spherical coordinates, Lines in space, Intersection of Line and a Plane

Vector-Valued Functions and Motion in Space:

Functions of several variables, their limits and continuity, Quadratic Surfaces, Parametric representation of curves, Velocity and Acceleration, Arc length, Tangent, Normal, Bi-normal, Curvature & Torsion

Partial Differentiation:

Partial derivatives, Total Differentials, Chain Rule with More Variables, Directional derivatives

Applications of Partial Derivatives:

Optimization Problems, Extrema of functions of several variables, Conditional extrema, Lagrange Multipliers and Example

Multiple Integrals:

Double Integration, Order of Integration, Double Integrals in Polar Coordinates, Applications: Mass and Average Value, Moment of Inertia, Triple Integrals, Rectangular and Cylindrical Coordinates, Applications and Examples, Triple Integrals in Spherical Coordinates

Vectors in 3 Space:

Introduction to vectors, Scalar and vector product, Volume of parallelepiped and tetrahedron, Gradient of a Scalar Field, Divergence of a Vector Field, Curl of a Vector Field

Integration in Vector Fields:

Line Integral, Integration around Closed Curves. Work Done, Potential and Related Examples, Conservative and non-Conservative Fields, Green's Theorem, Divergence Theorem, Stoke's Theorem, Applications of Double and Triple integrals

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass. Pearson, USA.
- George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry
- Swokowski, Onlinick & Pence: Calculus
- Robert T. Smith & Roland B. Minton: Calculus
- Calculus: Early Transcendental by James Stewart, Brooks/Cole USA

Applied Physics

Area Scope:

The knowledge units in this area collectively encompass the following:

Course Outline:

Vectors:

Review of vectors, Ordinary Differentiation of Vector, Gradient of Scalar field, Divergence and Curl of Vector Field, Line, surface and volume integrals with their applications.

Mechanics:

Newton Laws and their Applications (Simple Accelerometer, Banked Curve and Rotor), Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass of two-particles, Many-particles and Solid Object, Rotational inertia of solid bodies.

Electricity & Magnetism:

Electric field due to Discrete and Continuous Charge Distributions, Electrostatic Potential of discrete and Continuous charges, Gauss's Law and its Applications,

Lorentz Force and Hall Effect, Ampere's Law, Magnetic Field due to current element (Circular Current Loop and Solenoid)

Waves &Oscillations:

Types of Waves and Superposition Principle, Wave Speed on a stretched string, Wave equation, Energy & Power of a Wave, Principle of Superposition and Standing Waves. Line and Surface Integrals with applications, Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation.

Optics and Lasers:

Huygens Principle, Two-slit interference, Single-Slit Diffraction, Resolving power of Optical Instruments, Lasers and laser light, Working principle of lasers

Atomic and Nuclear Physics:

Planck's explanations of Black Body Radiation, Photoelectric Effect, Compton Effect, De-Broglie Hypothesis, X-rays and Moseley's Law, Atomic Nucleus and Properties of Nucleus, Radioactive Decay and Radioactive Dating.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignments, project report, quizzes, end-semester exam

Suggested Books:

- Halliday, Resnick and Walker, "Fundamentals of Physics" 10th Edition Extended
- Hugh D. Young and R.A. Freedman, University Physics. 12th Edition
- Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, 09th Edition.

Chemistry for Engineers

Area Scope:

This chemistry course emphasizes the fact that engineers should have a significant understanding in basic sciences such as chemistry. The contents of the course are context based and are thoroughly related to real world problems such as clean energy devices, combustion, and environmental degradation.

Course Outline

Introduction:

Chemical calculations and stoichiometry, chromatography, thermogravimetry, algebraic method of balancing chemical equations, chemical reaction types, precipitation, acid-base, oxidation state; molarity, limiting reactants, and product yields.

Structure and Chemical Bonding:

Electronic configuration; metallic, ionic and covalent bonding; electronegativity, bond polarity, and bond strength, mass spectrometry and atomic mass unit.

Electrochemistry:

Laws of electrolysis, the electromotive force (EMF), galvanic cells, batteries, corrosion (theories, inhibition and protection).

Air Pollution:

Interaction of solar radiation with atoms and molecules in the atmosphere.

Aqueous Solutions:

The equilibrium state, equilibrium constants, Le Chatelier's principle, quantitative calculations; acid-base equilibria, pH, buffers. Standardization of solutions for titration.

Nano-Chemistry:

Thin films, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD)

Polymers and Adhesive Chemistry:

The systematic chemistry of carbon compounds; nomenclature and properties of common organic functional groups; fundamentals of polymer chemistry; adhesives and bonding fundamentals.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignments, project report, quizzes, end-semester exam

Suggested Books:

- Chemistry, The Molecular Nature of Matter and Change with Advanced Topics Martin S. Silberberg and Patricia G. Amateis, McGraw-Hill Education, 8th Edition (2017)
- Chemistry, The Central Science, Theodore L. Brown et al. 13th Edition (2014)
- Applied Chemistry: A textbook for Engineers and Technologists by Roussak and Gesser (2013)
- General Chemistry by Donald A. McQuarrie et al , 4th ed. (2011)
- Water Chemistry, Stanley E. Manahan, CRC Press (2011)
- Environmental Chemistry, Colin Baird and Michael Cann, 3rd Edition (2005)
- General Chemistry, Kenneth W. Whitten et al. 6th Edition (2000)
- Chemistry: The Molecular science, Olmsted and William (1994)
- Engineering Materials 1: An Introduction to Properties, Applications and Design, Fifth Edition, David R. H. Jones and Michael F. Ashby (2018)
- Engineering Materials 2: An Introduction to Microstructures and Processing, Fourth Edition, Michael F. Ashby and David R. H. Jones (2013)

Social Sciences Courses

Sociology for Engineers

Area Scope:

This course is meant to provide engineering students, with an opportunity to view the discipline of sociology from the engineering perspective and will highlight its application to engineering profession. This will also enable the engineers to fit their technical ideas into a socially acceptable product /project in a more successful manner. The knowledge units in this area collectively encompass the following:

- To introduce to the methods and philosophy of the social science to help their understanding of the socio-cultural dimension of human existence as a fundamental reality in engineering projects etc.
- To provide opportunity for students to begin the process of considering social problems/ issues while designing engineering products.
- To allow engineers to play a pro-active role in critical discussions of social issues specifically.
- To demonstrate comprehension of roles and functions of various social institutions, state organizations, Professional bodies and relationships for analyzing their social impact Assessment.

Course Outline:

Fundamental Concepts and Importance of Sociology for Engineers

What is sociology? Nature, Scope, and Importance of Sociology, Sociological Perspectives and Theories, Social Interactions, Social Groups/ Social Institutions & their interface with Engineering Project/services, Sociology & Impact of Technology & Engineering Products/Projects on Society.

Cultural Impacts of Engineering Projects on Society

Definition of Culture, Types of Culture & Elements of Culture, Culture & Power, Authority, Dominance Socialization and Personality, Role of Engineering Projects on Culture, social norms and values of Society, Cultural Infusion of Engineers in Society

Theoretical Perspective of Sociology: Diffusion and Innovation; Adoption and Adaptation; Social development; Community Development

Community Development & Social consequences of Industrialization, Development Processes of Societal Development, Cooperation and Conflict in Community Development in Engineering Context.

Understanding of Societal & Ethical Norms and Values for Engineers

Engineering Ethics, Engineering product/services for less privileged, Role of Engg & Technology in addressing Social inequality, Core Social Values/Norms affecting Engg Performance

Organizational Social Responsibility (OSR) of Engineers

- Extent to which development intend to sensitize societal and under-privileged needs
- Gender inclusiveness and balance
- Special and Disadvantaged Community of the Area
- Planning for community inclusiveness
- Societal Obligation of Engineers

Engineers, Society and Sustainability

Social System and Concept of Sustainable Development Technology and Development, Population Dynamics in Pakistan, Causes and Consequences of Unplanned Urbanization, Community Development, Programs in Pakistan, Community Organization & Engineering Projects, Population, Technological & Industrial expansion and Development with focus on social/human/ethical dimensions.

Industrial & Organizational Psychology

Interpersonal Relations, Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Impact of Technology on human feelings and level of Sensitivity

Climate Change and Ecological Friendliness from Engineering Perspective

Ecological Processes, Ecosystem and Energy, Impact of Engineering Projects on Eco System & Human Ecology, Industrial & Environmental impact on Population & General Masses, Technological Intervention, Ecosystem and Physical

Environment, Social Impact of Technology & Engineering Products & Services (Solid Waste Disposal, Pollution control etc.).

Social Approaches and Methodologies for Development Administration & Stakeholders Analysis:

All Phases of the Project (pre, post and execution) Structured, Focused Group, Stakeholder Consultative Dialogues etc. Dynamics of Social Change, Sociology of Change and Industrial Development, Social Change due to Technology Driven Economic Growth.

SIA (Social Impact Assessment):

Base line and need-assessment, evaluation and impact assessment surveys of the development projects. Role of Engg & Technology for Creating Social Cohesiveness & Societal Integration. Technology Based change in Collective Behavior, Social Audit of Engineering Projects.

Engineering Intervention for Social Stratification:

Factors of Social Stratification, Engineering Interventions for addressing Social Stratification, Social Mobilization through Technological Innovation.

Case Studies of Different Development Projects in Social Context

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Project / Field Visits, Group discussion, Community Service, Report Writing, Social Impact Review and Social Audit of Engg Project

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Godhade, J. B., and S.T. Hunderkari. 2018. Social Responsibility of Engineers. International Journal of Academic Research and Development. Latest edition.

- Nichols, S.P. and Weldon, W.F. latest edition. Professional Responsibility: The Role of Engineering in Society Center for Electro-mechanics, The University of Texas at Austin, USA.
- Aslaksen, E.W. latest edition. The Relationship between Engineers and Society: is it currently fulfilling its potential? Journal and Proceedings of the Royal Society of New SouthWales, latest edition. Gumbooya Pty Lte, Allambie Heights, Australia.
- Bell, S. Engineers, Society and Sustainability. Synthesis Lectures on Engineers, Technology, and Society. Edited by Caroline Baillie, University of Western Australia. Morgan and Claypool Publishers, latest edition
- Jamison, A., Christensen, S.H., and Lars, B. latest edition. A Hybrid Imagination: Science and Technology in Cultural Perspective.
- Vermaas, P., Kroes, P., Poet, I., and Houkes, W. latest edition. A Philosophy of Technology: From Technical Artefacts to Socio technical systems.
- Mitcham, C., and Munoz, D. Humanitarian Engineering. Morgan and Claypool Publishers, latest edition Riley, D. Engineering and Social Justice. Morgan and Claypool Publishers.
- Bugliarello, G. latest edition. The Social Functions of Engineering: A Current Assessment, a Chapter in “Engineering as a Social Enterprise.

Sociology

Area Scope:

The knowledge units in this area collectively encompass the following:

- To introduce the necessary subject knowledge and understanding required for the successful study of Sociology and related Social Science disciplines at undergraduate.
- To develop skills of application, analysis and evaluation in the context of the study of Social Science.
- To develop a knowledge and understanding of sociology both at a global and national level.
- To introduce the planning and organization skills necessary to develop as independent, autonomous learners.

- To develop the confidence and competence of the students as learners and to assist them in taking some responsibility for their own learning through directed study and reading.

Course Outline:

- Introduction: Sociological Perspective,
- The Development of Sociology,
- The Role of Values in Sociology, Prejudice In Early Sociology,
- Theoretical Perspective in Sociology. Culture: Components of Symbolic Culture, Subcultures and Counter Cultures, Cultural Universals, Animals and Culture,
- Technology and Global Village, Sociology and New Technology.
- Socialization: Social Development of Self, Mind, and Emotions,
- Socialization into Gender Social Structure and Interaction,
- Social Institutions. Research in Sociology: Research Model, Research Methods. Experiments, Ethics,
- Bureaucracy and Formal Organizations, Rationalization of Society, Formal Organizations and Bureaucracy,
- Voluntary Associations Social Classes, Economy, Politics, Power and Authority, Family, Medicine, Health and Illness, Population and Urbanization, Social Movements
- Social Psychology with special reference to attitudes, attributions and behavior, Emotions, Cognition and Thinking, Reasoning, Problem-Solving and Creativity, Personality, Intelligence, and Abnormal Behavior, etc.
- Introduction to the Field of Organizational Behaviour
- Conflict and Negotiation in the Workplace
- Leadership in Organizational Settings and Organizational Culture
- Ethics: In General an introduction and the development of ethical theory.
- Ethics in Islam, a comprehensive view with different ethics approaches and Ethics Theories
- Research Methods for Society and Sociology

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Henslin, Sociology: A Down-to-Earth Approach, latest edition.
- D. Kendall, Sociology in our Times. Wadsworth Pub Co, latest edition.

Engineering Economics

Area Scope:

- Apply the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio
- Evaluate the cost effectiveness of individual projects using the methods learnt, draw inferences for investment decisions, and compare the life cycle cost of multiple projects.
- Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value

Course outline

Engineering Economics

- Role of engineers in business
- Economic decisions v/s design decisions
- Large scale engineering projects and types of strategic economic decisions
- Fundamental principles of engineering economics

Interest Rate and Economic Equivalence

- Interest: The Cost of Money
- Economic Equivalence

- Development of Formulas for Equivalence Calculation
- Unconventional Equivalence Calculations

Understanding Money and Its Management

- Nominal and Effective Interest Rates
- Equivalence Calculations with Effective Interest Rates and with Continuous Payments
- Changing Interest Rates
- Debt Management
- Investing in Financial Assets

Present-Worth Analysis

- Project Cash Flows
- Initial Project Screening Methods: payback Screening and Discounted Cash Flow Analysis
- Variations of Present-Worth Analysis
- Comparing Mutually Exclusive Alternatives

Annual Equivalent-Worth Analysis

- Annual Equivalent-Worth Criterion
- Capital Costs versus Operating Costs
- Applying Annual-Worth Analysis
- Life-Cycle Cost Analysis
- Design Economics

Rate-of-Return Analysis

- Rate of Return and Methods of Finding
- Internal Rate-of-Return Criterion
- Mutually Exclusive Alternatives

Cost Concepts Relevant to Decision Making

- General Cost Terms; Classifying Costs for Financial Statements
- Cost Classifications for Predicting Cost Behavior
- Future Costs for Business Decisions
- Estimating Profit from Production

Depreciation and Corporate Taxes

- Asset Depreciation: Economic versus Accounting
- Book and Tax Depreciation Methods (MACRS)
- Depletion
- Income Tax Rate to be used in Economic Analysis
- The Need for cash Flow in Engineering Economic Analysis

Developing Project Cash Flows

- Cost-Benefit Estimation for Engineering Projects
- Developing Cash Flow Statements

Project Risk and Uncertainty

- Origins of Project Risk
- Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

Special Topics in Engineering Economics

- Replacement Decisions
- Capital Budgeting Decisions
- Economic Analysis in the Service Sector

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Contemporary Engineering Economics by Chan S. Park, latest edition, Pearson ISBN: 9780134105598
- Engineering Economic Analysis by Donal G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, latest edition, Oxford University Press, ISBN: 978-0199339273

- Engineering Economy by Leland T. Blank and Anthony Tarquin.

Social Psychology

Area Scope:

To impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.

Course Outline:

- Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups,
- basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes,
- Language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social identities, conformity, group influence, moral and ethical issues, harassment,
- Corruption and its control, thinking processes and decision making.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Edward Alsworth Ross, “Social Psychology”, Macmillan, latest edition.
- Emory Stephen Bogardus, “Essentials of Social Psychology”, Univ. of Southern, California Press, latest edition.

- Hewstone, M., & Stroebe, W. (Eds.), “Introduction to Social Psychology”, 3rd ed., Oxford: Blackwell Publishers, latest edition.
- Lesko, W.A. “Readings in social psychology General, classic, and contemporary selections, latest edition,

Community Services

Area Scope:

Community service-learning provides a variety of benefits to the students and the community service has a unique way of developing an individual's leadership skills, sense of community, civic ethic, self-esteem, and other personal characteristics. Every service activity benefits a specific individual or group. Whether it is building homes for the poor, serving victims of chronic or terminal illness, tutoring children, addressing environmental needs or any other service, there is a person or group who ultimately benefits from your time. Finally, the organization where you conduct your service benefits enormously. Volunteers can make important contributions to Community benefit agencies (nonprofit) and government programs in their attempt to deal with the complex and growing needs of society.

Course Outline:

- Develop and implement service programs
- Develop workplace communication strategies
- Analyze impacts of sociological factors on clients in community work and services
- Manage and promote diversity
- Manage legal and ethical compliance
- Facilitate workplace debriefing and support processes
- Reflect on and improve own professional practice
- Manage work health and safety
- Assess co-existing needs
- Coordinate complex case requirements
- Develop, facilitate and review all aspects of case management
- Provide case management supervision
- Undertake project work
- Lead and manage team effectiveness

- Manage personal work priorities and professional development
- Manage meetings

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Schools and Community: The Communitarian Agenda in Education By James Arthur; Richard Bailey, Falmer Press, latest edition.
- Studying Service-Learning: Innovations in Education Research Methodology by Shelley H. Billig, Alan S. Waterman , Lawrence Erlbaum Associates, latest edition.

Organizational Behavior

Course Outline:

Introduction to Organizational Behavior

- Organizational Disciplines and topics
- Psychological Perspective
- Social-Psychological Perspectives

Structure and Control in Organization

- Introduction of Bureaucracy
- Managerial Work
- Contingency theory
- Organizational Design

Individual and Work Learning

- Learning Theories
- Learning and Work

Stress

- Types of Stress and Work
- Occupational Stress Management

Individual Differences

- Personality and its factors
- Personality dimensions and social learning Intelligence

Motivation and Job Satisfaction

- Needs at Work
- Theories of Motivation and job satisfaction
- Correlates of Job satisfaction

Group and Work

- Social Interaction
- Dramaturgy and impression Management
- Social Skill

Group and Inter group Behavior

- Group Structure & Norms
- Group Processes
- How throne Studies

Leadership

- Leadership as an attribute
- Leadership Style

Patterns of Work

- Work-the classical approach
- Marx, Weber, & The critique of labor
- Foucault & Disciplinary Power
- Conflict and Consent in Work
- The labor Process debate
- Work place control and resistance
- Industrial conflict and industrial relations

Organizational Culture

- Organizational culture and strategic management
- Exploring organizational culture
- Evaluating concept of culture

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Fincham, R., & Rhodes, P. latest edition, Principles of Organizational Behaviour, Oxford.
- Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. latest edition, Human Resource Management, 5th ed., McGraw Hill.
- Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
- Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
- Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

Professional Ethics

Area Scope:

The objective of this course is to grasp ideals and principles as they have been spelled out in a variety of traditional ethical systems and to apply these conceptual structures and guidelines to major problems and dilemmas of engineering practices in a corporate culture.

Course Outline:

- Engineering Ethics, Ethical concepts, and Types
- Moral Autonomy, Kohlberg's & Gilligan's Theory
- Profession and Professionalism

- Moral Reasoning, Ethical Theories
- Critique codes of ethics
- Moral frameworks, Personal commitments and professional life
- Engineering as social experimentation
- Involving the public in the design process, Case studies for engineering as social experimentation
- Assessment of safety and risk, Design considerations, uncertainty
- Risk-benefit analysis, Safe-exit and fail safe systems
- Case Studies for the Design Process Case studies in impact of safety/risk on design
- Employee/employer rights and responsibilities
- Confidentiality and conflict of interest
- Whistle-blowing, case studies on professional behavior/policies on the job
- Environment, sustainable development, Multinational corporations, globalization of engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005.
- Fundamentals of Engineering Economics, 3rd ed., by Chan S. Park
- Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008.
- The Seven Habits of Highly effective people by Stephan r. Covey
- Principle Centered Leadership Stephan r. Covey
- Change your lens change your life by (Faiez H. Seyal)
- How to Manage by Ray Wild
- Happiness by Richard Layar

Cultural Courses

Islamic Studies and Ethics

Course Description:

The Islam is a religion of peace and harmony for all humans based on knowledge and guidance in the Holy Quran. The basic teachings of Islam are comprehensive, practicable and universal. Therefore, this course briefly presents the vision of life and applied aspects of ethical system.

Area Scope:

- To enhance understanding of Islamic Culture and Civilization
- To understand values and social system in Islam
- To improve students' ethical and professional skill and critical thinking

Course Outline:

Islam – Religion of Peace and Harmony

- Basic Concepts – Islam, Quran and Hadith
- Faith and Religious Life
 - Selected Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
 - Selected Verses of Surah Al-Mumanoon Related to Characteristics of Faithful (Verse No-1-11)

Islamic Culture and Civilization

- Basic Concepts and of Characteristics of Islamic Culture and Civilization
- Education System of Islam
- Political System of Islam – Dynamics, Sovereignty and Institutions
- Economic System of Islam – Principles, Riba, Trade and Commerce
- Acceptance of Other Religions – Interfaith Harmony
- Foreign Policy

Social System of Islam

- Basic Concepts of Social System in Islam
- Elements of Family and their Rights - Parents, Women, Husband & Wife, Children

- Inheritance – Rights and Laws
- Social Rights – Neighbors, Relatives and Society
- Equality and Brotherhood
 - Selected Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Concept of Welfare State – Period of Khilafat-e-Rashida

Professional Ethics and Morality

- Basic Concepts - Islam and Ethics
 - Selected Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)
- Profession and Professionalism in Islam
- Characteristics of a Professional
 - Truthfulness, Honesty, Sincerity, Patience, Gratitude, Meditation and Research
- Role for Human Safety and Environment
- Time Management
- Prophet Muhammad (PBUH) – Role Model
 - Selected Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
 - Selected Verses of Surah Al-Ihzab Related to Adab Al-Nabi (Verse No. 6, 21, 40, 56, 57, 58)

Islam and Science

- Islam and Science
- Role of Muslims in Science and Education
- Critical Thinking and Innovation
 - Selected Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
 - Selected Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No1,14)

Note: All topics should be taught/covered in the light of relevant Verses from Holy Quran and Ahadiths.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Al-Qur'ān (selected text).
- Sayyid Tāhir Rasūl Qādri 52 دروس قرآن (Karachi: Islamic Research Academy, 7th ed., 2017).
- Sayyid Hasan-uddin Ahmad، تعلیمات قرآنی 2-vols., (Karachi: Jasarat Publications, 1998).
- Muhammad Shafi، معرف القرآن (Karachi: Dar-ul-Isha'at, 2000).
- Sayyid Abu'l A'lā Mawdūdī، تفہیم القرآن 6vols., (Lahore: Islamic Publications, 1998). [Preambles of all (114) chapters.]
- Amin Ahsan Islahi، تدبر القرآن (Lahore: Farān Publications, 2005).
- Khawaja Abdul Waheed، موضوعات قرآن و انسانی زندگی (Islamabad: Islamic Research Institute, 3rd ed., 1997).
- Khurram Murad، رب کا پیغام (Lahore: Manshūrat, Mansoora, 2000)
- Hameed ullah Muhammad, "Emergence of Islam", Islamic Research Institute (IRI), Islamabad
- Hameed ullah Muhammad, "Muslim Conduct of State" Sh Muhammad Ashraf, Kashmir Bazar, India (Latest Edition)
- Hameed ullah Muhammad, "Introduction to Islam" Compiled by The CSS Point, www.thecsspoint.com
- Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan, (Latest Edition).
- H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989).
- Islamic Education by A. S. Bukhari & M. D Zafar, Latest Edition.
- Muslim's character by M. Al-Ghazali, Latest Edition.

Pakistan Studies and Global Perspective

Area Scope:

The knowledge units in this area collectively encompass the following:

- Have a better understanding of the rationale for the creation of Pakistan.
- Enable students to contribute in social, political and economic growth of Pakistan.
- Become a part of strong nation with a sense of ownership and responsibility towards Pakistan
- Play an active role toward sustainable development of Pakistan in global perspective.

Course Outline:	Time Duration
Historical and Ideological Perspective	5 hrs
a. Pakistan Movement <ul style="list-style-type: none">• Aligarh Movement• Two Nations Theory	
b. Founders of Pakistan <ul style="list-style-type: none">• Allama Muhammad Iqbal• Quaid-e-Azam Muhammad Ali Jinnah• Other Leaders (Women and other Pakistan Movement Leaders)	
c. Quaid's Vision for Pakistan	
d. Kashmir – An unfinished Agenda of Partition	
Constitution of Pakistan	4 hrs
a. An overview of constitutional development in Pakistan	
b. Salient features of the Constitution of 1973	
c. Constitutional Amendments	
d. Fundamental Rights and Responsibilities of Citizens	
Contemporary Pakistan	4 hrs
a. Pakistan's society, culture and demography – celebrating diversity	
b. Current Challenges: social, economic, environmental, political and external	
c. Nation's resilience in War on Terror	

Economy of Pakistan **4 hrs**

- a. An overview of Economy
- b. Services, Manufacturing and Agricultural Profile of Pakistan
- c. Regional Economic Cooperation
- d. One Belt One Road (OBOR) – CPEC

Land of Opportunities **4 hrs**

- a. Physical features: diversity and beauty
- b. Natural resources - mineral, water, energy, agriculture & livestock, and marine resources
- c. Tourism and Culture

Pakistan's Foreign Policy **5 hrs**

- a. Foreign Policy – Principles and Objectives
- b. Relations with Neighbors
- c. Major Economies
- d. Muslim World
- e. Geo-political and strategic significance of Pakistan in Regional and Global Politics

Pakistan in pursuit of Global Agenda **4 hrs**

- a. SDGs-2030 - Pakistan Goals
- b. Commitments on Climate Change
- c. Peace and Security

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Khalid B. Sayeed, Pakistan: The Formative Phase 1857 – 1948, Pakistan Publishing House, 1960
- Gulam Allana, Quaid-e-Azam: the story of Pakistan, Ferozsons, 1967.
- Shahid M. Amin, Pakistan's Foreign Policy: A Reappraisal, Oxford University Press, 2010.
- S. Akbar Zaidi, Issues in Pakistan's economy, Oxford University Press, 2003.
- Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003
- Rafi Raza, *Pakistan in Perspective 1947-1997*, Oxford University Press, 2003
- Sharif-ul-Mujahid, *The Ideology of Pakistan*, Progressive Publishers, 1974.
- Ziring Lawrence, *Pakistan in the Twentieth Century*, Oxford University Press, 1997 -
- Burke S. M. & Ziring Lawrence, *Pakistan's Foreign Policy*, Oxford University Press, 1973. Mohammad Qadeer , Pakistan
- Climate Change Policies-Ministry of Climate Change, Islamabad-
<http://mocc.gov.pk/>
- Sustainable Development Goals (SDGs)- www.pc.gov.web/sdg/sdgpak
- Economic Survey of Pakistan- http://finance.gov.pk/survey_1617.html
- Foreign Policies - Ministry of Foreign Affairs, Pakistan
<http://mofa.gov.pk/>
- Population Census of Pakistan- Economic Survey of Pakistan
http://finance.gov.pk/survey_1617.html
- Issues in Pakistan's Economy by S. Akbar Zaidi, ISBN: 0195790529.
- Pakistan's Foreign Policy: A Reappraisal by Shahid M. Amin. ISBN: 0195798015
- Newspapers editorial and selected journalistic writings on current affairs.
- Pakistan (Lands, Peoples, & Cultures) by Carolyn Black, Bobbie Kalman. ISBN: 0778797147

Management Sciences Courses

Engineering Project Management

Area Scope:

The primary objective of this course is to get the fair understanding of core issues pertaining to Engineering Project Management. This course is aimed at providing both basic and some advanced exposure to emerging trends in the field of Project Management, so as to enable the engineering professionals of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources with due regards to stakeholders set of expectations. Engineering students will learn key Project Management skills and strategies and will be able to face emerging challenges.

Core Objectives of this course are:

- To develop competencies in project costing, budgeting, and financial appraisal;
- To gain exposure to project Planning Control and Management, using standard tools and schedule variance analysis;
- To appreciate the elements of risk and quality in hi-tech projects;
- To learn Project Management by “practice”, through the medium of “End of Semester Group Project”; and
- To appreciate and understand the use of computers in Project Management, especially a tool like MS Project & Primavera etc.

Course Outline:

Project Management Concepts

History of Project Management, Introduction to Project Management, Project, Program & Portfolio Management, Project characteristics, Objectives& Requirements, Project Phases/Stages, Project Life Cycle, Project Environment, Project Scope & Project Charter, Project Manager, Project Stakeholder Analysis.

Project Proposal Development

Project Proposal, Characteristics of good proposal, Types of Proposals, Request for Proposal, Request for Quotation etc.). Proposal Templates etc.

Project Feasibility

Brief review of various aspects of Project Feasibility like Technical, Social, Managerial, Economic, Financial & Marketing, Administrative etc.

Project Selection Criteria (Economic Analysis of Engineering Projects)

Using Break Even Analysis, Cost Benefit Ratio, Internal Rate of Return, Net Present Value etc.

Project Contract & Procurement Management

Engineering contracts, Type of contracts, understanding of procurement Process & Cycle, PPRA Rules

Project Planning and Scheduling

Project Planning (Resource & HR Planning), Work Breakdown Structure, Project Network & Scheduling, Manning Schedule and Activity Charts, Critical Path Method (CPM)/Project Evaluation & Review Techniques

Project Costing & Estimation

Cost Estimation in Projects, Cost components in projects and methods for cost estimation in projects, Cost Control in Projects, Estimation of Outstanding Work, Earned Value Management, Schedule & cost variance analysis

Project HRM & Communication Management

Effective organization and communication for Successful Projects, Project Organizational Structures (Project matrix and project based organizations), Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and Managing effective project team, Selection & control mechanism of HRM in Projects, Effective Communication Plan.

Project Risk Management

Definitions Project Risk, Project Risk Management Tools, Types of Project Risk, Project Risk Assessment, Risk Identification and Mitigation, Monitoring & Controlling Risk, Generic Risk Management Strategies & Technique.

Computer Application in Project Management

Basic/Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 Software in Project Management

Project Quality Management

Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as applied to Project Management, Project Quality Management Plan, Quality Management Processes and Strategies

Project Closure & Termination

Project Evaluation, defining project success, Project Completion Criteria, Project Audit, Project Termination & When to close a project, the termination process, Project Close Up & lesson learnt, & Project Archive

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Project Management: A system Approach to Planning, Scheduling and Controlling latest Edition, Harold Kerzner
- Bennett, F. Lawrence. Latest edition. The management of engineering. New York: Wiley.
- Cleland, David. Latest edition Field guide to project management. New York: Wiley.
- Eisner, H. Essentials of project management and systems engineering management. New York: Wiley, latest edition.
- Frame, J. D. Managing projects in organizations. San Francisco: Jossey-Bass
- Goldratt, Eliyahu. Latest edition Critical chain. North River Press.
- Haynes, M.E. Project management: From idea to implementation. Los Altos, CA: Crisp Publications latest edition.
- Lewis, James, Project planning, scheduling & control. New York: McGraw-Hill, latest edition.

- Lewis, James, P. Latest edition. Mastering project management. New York: McGraw-Hill
- Lientz, Bennet & Rea, Kathryn. Latest edition. Project management for the 21st century. San Diego: Academic Press.
- Miller, Roger & Lessard, Donald. Latest edition. The strategic management of large engineering projects. Cambridge, MA: MIT Press.
- Nicholas, J.M. Managing business & engineering projects. Englewood Cliffs, NJ: Prentice Hall, latest edition
- Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. 1994. Project management: Engineering, technology, and implementation. Englewood Cliffs, Prentice-Hall latest edition.
- Project Management by Adrienne Watt, latest edition.
- J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. Latest edition.

Geospatial Project Management

Course Outline:

- Introduction to Geospatial Program Development
- Role of planning and management in developing a successful geospatial technology based projects
- Governance and Coordination
- Role of planning and development, organizational structures, leadership and governance, and communications in successful geospatial projects
- Role of project leadership, team building, capacity building (including opportunities for geospatial certification)
- Multi-organizational agreements (i.e. collaborations) in contributing to successful geospatial programs
- The financial aspects, such as funding, financial management, monitoring, and reporting
- Risk management that contribute to successful geospatial programs and the completion of projects on time and on budget
- Legal issues influence the geospatial sector
- Ethical issues influence the geospatial sector

- Role of technical design (system configuration, data, applications) and the development/maintenance of these technical components in contributing to successful geospatial programs
- Role of the operational environment in helping to shape and sustain successful geospatial programs
- Modern tools and technologies in practice for successful geospatial project management
- Current and emerging trends, including the consequences of choosing proprietary vs. open source software solutions
- Modern Case Studies

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested books:

- Croswell, Peter L. 2011. The GIS Management Handbook. Des Plaines, IL, Kessey Dewitt Publications in association with URISA
- Obermeyer, Nancy J. and Pinto, Jeffrey K. 2008. Managing Geographic Information Systems (Second Edition). New York, The Gilford Press
- Tomlinson, Roger 2013. Thinking about GIS: Geographic Information System Planning for Managers (Fifth Edition). Redlands, CA, Esri Press
- Hanebuth, Austin Smith 2015. Applications in Geospatial Project Management Student Manual. Digital Quest Incorporated
- Harder, Ormsby, and Balstrøm 2013. Understanding GIS: An ArcGIS Project Workbook. Esri Press

Entrepreneurship

Area Scope:

- Develop a business plan with an appropriate business model
- Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career
- Demonstrate the ability to find an attractive market that can be reached economically

Course Outlines

- Basic Concept-Entrepreneurship
- Innovation and Entrepreneurship
- Basic Plan Development Cycle
- Intellectual Rights
- Financial and Legal Modalities
- Marketing
- Industrial Competitiveness
- Gap Analysis, Critical Thinking and Idea Generation
- Business Plan Development
- Successful Case Studies (local)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Michael J Etzel, Bruce J Walker, William J Stanton, Marketing, McGraw-Hill, latest edition.
- William D. Bygrave and Andrew Zacharak, Entrepreneurship 2nd Edition, Wiley, latest edition.

- Entrepreneurship by Hisrich, McGraw- Hill, latest edition.
- Principles of Marketing, Cotrell McGraw- Hill, latest edition.
- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship, latest edition.
- P.N. Singh: Entrepreneurship for Economic Growth, latest edition.
- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker, latest edition.
- John B. Miner: Entrepreneurial Success, latest edition.
- “Marketing that Works: How Entrepreneurial Marketing Can Add Sustainable Value to Any Sized Company”, by Leonard Lodish, Howard Morgan, Shellye Archambeau and Jeffrey Babin, Pearson FT Press, latest edition.
- "Entrepreneurial Marketing," Lessons from Wharton's Pioneering MBA Course, Morgan, H. L., A. Kallianpur, and L. M. Lodish, John Wiley & Sons, latest edition.

Principles of Management

Area Scope

- The focus will be on the learning fundamental principles of management and of managing people and organization.
- Develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Outline:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making

- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system, process and techniques of controlling
- Management and Society: future perspective

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Stephen P. Robins, Mary Coulter: Management, latest edition.
- H. Koontz Odonnel and H. Weirich: Management, latest edition.
- Mc Farland: Management: Foundation and Practice, latest edition.
- Robert M. Fulmer: The New Management, latest edition.

Engineering Management

Course Outlines

- Industrial networks
- Fundamentals of Product and Process development
- Business Community and New Generations of Managers
- Practical Skills Knowledge and Experience in Commercialization of New Technological Inventions
- Use of Multidisciplinary Science Based Knowledge,
- Problem Solving, Teamwork and Outreach Activity,
- Major steps in proof of concept to intellectual property protection,
- Prototype development
- Fabrication and assembly routes

- Materials procurement
- Identification and creation of new markets
- Development of business plan
- Appropriate technology and marketing
- Distribution and financing
- Routes and strategies for specific technology under development.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- R. A. Bulgeman, Strategic Management of Technology and innovation, latest Edition McGraw Hill.



Available at:
<http://www.pec.org.pk>

