

CURRICULUM
OF
ENVIRONMENTAL ENGINEERING
B.E., B.Sc

(Revised 2008)



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

Dr. Syed Sohail H. Naqvi	Executive Director
Prof. Dr. Riaz ul Haq Tariq	Member (Acad)
Miss Ghayyur Fatima	Deputy Director (Curri)
Mr. M. Tahir Ali Shah	Assistant Director
Mr. Shafiullah Khan	Assistant Director

Composed by: Mr. Zulfiqar Ali, HEC, Islamabad

CONTENTS

1.	Introduction	6
2.	Unified Framework B.E/B.Sc of Environmental Engineering.	8
3.	Scheme of Studies	11
4.	Details of Courses	14

PREFACE

Curriculum development is a highly organized and systematic process and involves a number of procedures. Many of these procedures include incorporating the results from international research studies and reforms made in other countries. These studies and reforms are then related to the particular subject and the position in Pakistan so that the proposed curriculum may have its roots in the socio-economics setup in which it is to be introduced. Hence, unlike a machine, it is not possible to accept any curriculum in its entirety. It has to be studied thoroughly and all aspects are to be critically examined before any component is recommended for adoption.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor's Committee, the curriculum of a subject must be reviewed after every 3 years.

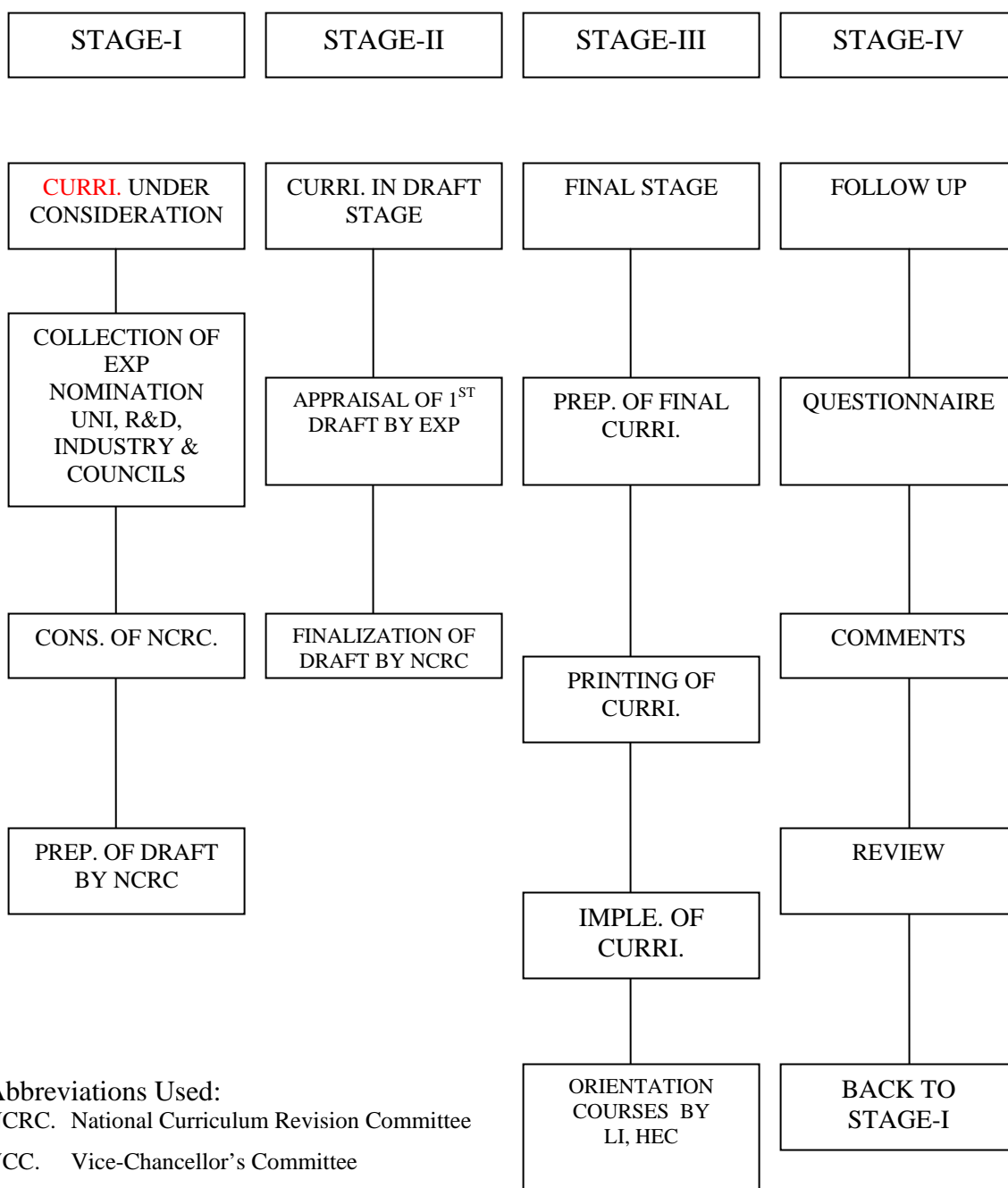
A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The new BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours. The engineering degree will devote 65-70% of the curriculum towards engineering courses, and 35--30% to non Engineering courses.

For the purpose of curriculum revision various committees are constituted at the national level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations and respective accreditation councils. The National Curriculum Revision Committee for Environmental Engineering meeting held on March 6-8 2008 at the HEC Lahore, in continuation of its earlier meeting held on August 21-23, 2007 at HEC Regional Centre, Karachi, revised the curriculum in light of the unified template. The final draft prepared by the National Curriculum Revision Special Committee, duly approved by the competent authority, is being circulated for implementation in the concerned institutions.

DR. RIAZ-UL-HAQ TARIQ
Member Academics

July 2008

CURRICULUM DEVELOPMENT



- Abbreviations Used:**
- NCRC. National Curriculum Revision Committee
 - VCC. Vice-Chancellor's Committee
 - EXP. Experts
 - COL. Colleges
 - UNI. Universities
 - PREP. Preparation
 - REC. Recommendations
 - LI Learning Innovation
 - R&D Research & Development Organization
 - HEC Higher Education Commission

INTRODUCTION

Final Meeting of the National Curriculum Revision Committee was held in HEC Regional Centre Lahore from 6 to 8 March, 2008. The following participated in the Meeting:

Dr. Mohammad Aslam Khan, Foreign Professor, University of Peshawar, Peshawar	Convener
Prof. Dr. M. A. Q Jehangir Durrani, Department of Civil & Environmental Engg., University of Engineering & Technology, Peshawar	Member
Prof. Dr. Muhammad Shafqat Ejaz, Chairman Department of Environmental Engg., NED University of Engineering & Technology, Karachi	Member
Prof. Dr. Saleem Raza Samo, Professor, Department of Energy & Environment Engg., Quaid-e-Awam University of Engg. Science & Technology (QUEST), Nawabshah	Member
Mr. Abdul Jabbar Bari, Professor and Director, Institute of Environmental Engineering, University of Engineering & Technology, Lahore	Member
Dr. Perveen Akhter, Deputy Chief Scientist, Head, Health Physics Division, PINSTECH P.O. Nilore, Islamabad.	Member
Prof. Dr. Khan Muhammad Brohi, Mechanical Engg. Department, Mehran University of Engg & Technology, Jamshoro	Member
Mr. Aurangzeb Khan, Head of the Department Environmental Studies Centre, Hamdard University, Karachi	Member

Dr. Zahiruddin Khan,
Associate Professor,
Institute of Environmental Science & Engg.
National University of Sciences & Technology,
Tamiz-ud-Din Road, Lalkurti, Rawalpindi

Member /
Secretary

The meeting commenced with the recitation from the Holy Quran. The Convener of the Committee welcomed the participants and explained the objectives of the meeting. Following which the Committee discussed and finalized the list of the courses and assigned credit hours as per the framework approved by HEC and PEC jointly. The National Curriculum Revision Committee agreed upon the following:

- | | | |
|----|---|-------|
| a. | Total credit hours 133 (3 credit hours to this may be added by universities through an elective course by themselves) | |
| b. | Number of semesters | 8 |
| c. | Percent engineering courses | 66.17 |
| d. | Percent of non-engineering courses | 33.83 |

Where annual system is in vogue, the scheme of study will be tailored accordingly.

The Committee also re-examined the preliminary draft course contents and finalized.

Further, the Committee made the following recommendations:

- In order to improve the communication skills of the students every student should make a presentation at the end of each engineering course
- Although three courses have been recommended by the committee in English and Computers in view of HEC guidelines, it is felt that two courses each will suffice the requirements in both cases.
- Minimum credit hours required per semester may be adjusted as per revised curriculum.
- The laboratories may be upgraded as per revised courses recommended.
- Capacity of the teaching and laboratories staff may also be enhanced through refresher courses as needed.

UNIFIED FRAMEWORK

FOR B.E./B.Sc OF ENVIRONMENTAL ENGINEERING

Duration: 4 years

Semester: 8

Number of weeks per semester: 18 (16 for teaching and 2 for examination)

Total number of Credit Hours (CH): 133- 136

Number of Credit Hours (CH) per semester: 15 - 18 (17)

Engineering Domain Courses: 65 - 70% (66.17)

Non-Engineering Domain Course: 30 - 35% (33.83)

Number of Contact hours: 199

Non-Engineering Domain									
Knowledge Area	Subject Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits	% Area	% over all
Humanities	English	English-I	3	0	3	3	9	19.15	6.52
		English-II	3	0	3				
		English Communication Skills	2	1	3				
	Culture	Islamic Studies	2	0	2	2	4	8.51	2.90
		Pakistan Studies	2	0	2				
	Social Sciences	Environmental Issues & Ethics	3	0	3	2	5	10.64	3.62
Anthropology / Sociology of Development /Env. & Human Interaction / Psychology		2	0	2					
Management sciences		Engineering Economics	2	0	2	3	6	8.51	2.90
	--	Ecological management / Sustainable Development	2	0	2				
		Project Planning & Management	2	0	2				
Natural Sciences	Math	Mathematics-I	3	0	3	4	12	38.30	13.04
		Mathematics-II	3	0	3				
		Mathematics-III	3	0	3				
		Numerical Analysis	3	0	3				
	Physics	Applied Physics	2	1	3	1	3	8.51	2.90
	Chemistry	Environmental Chemistry	2	1	3	1	3	6.38	2.17
	Microbiology	Environmental Microbiology	2	1	3	1	3		
Sub-Total-I			41	4	45	17	45	100	33.83

Engineering Domain									
Knowledge Area	Subject Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits	% Area	% overall
Computing	Fundamentals	Computer Aided Learning	2	1	3	3	10	9.89	6.52
	Programming	Computer Programming	1	2	3				
	Design	Computer Aided Design and Drafting	2	2	4				
Engineering Foundation	--	Surveying	1	2	3	7	25	32.97	21.74
		Engineering Mechanics	3	0	3				
		Mechanics of Solids / GIS & Remote Sensing / Plumbing Design	3	1	4				
		Fluid Mechanics	3	1	4				
		Soil Mechanics	3	1	4				
		Water Pollution Control	3	1	4				
		Introduction to Environmental Engineering	3	0	3				
		Water Supply & Wastewater Engineering	3	1	4				
Major Based Core (Breadth)	--	Principles of Water and Wastewater Treatment	3	1	4	6	23	25.27	16.67
		Engineering Hydrology	3	1	4				
		Air & Noise Pollution Control	3	1	4				
		Solid Waste Management	3	0	3				
		Environmental Engineering Lab Techniques	2	2	4				
		Environmental Health & Safety	3	1	4				
Major Based Core (Depth)	--	Water Resources & Irrigation Engineering	3	1	4	5	17	20.88	13.77
		Environmental Impact Assessment	2	1	3				
		Cleaner Production Techniques	2	1	3				
		Energy Resources Management	3	0	3				

Inter-disciplinary Engineering Breadth (Electives)	--	Electrical Technology	2	1	3	2	7	6.59	4.35
		Thermodynamics	3	1	4				
Senior Design Project	--	Senior Design Project-I	0	3	3	2	6	4.40	2.90
		Senior Design Project-II	0	3	3				
Sub-Total-II			59	29	88	25	88	100.0	66.17
Grant Total (I+II)			100	33	133	42			
Industrial Training									
Grand Total						42	133		

NOTE:

Universities have the option to add course of 3 credit hours in the engineering foundation domain.

SCHEME OF STUDIES

B.E/B.Sc Environmental Engineering

Semester wise

Semester-1

Course No.	Course Title	Lec. - CH	Lab- CH	Total – CH
1	English – 1	3	0	3
2	Environmental Issues and Ethics	3	0	3
3	Introduction to Environmental Engineering	3	0	3
4	Computer Aided Learning	2	1	3
5	Surveying	1	2	3
6	Applied Physics	2	1	3
	Total	14	4	18

Semester-2

Course No.	Course Title	Lec.- CH	Lab - CH	Total- CH
1	Mathematics – 1	3	0	3
2	English – II	3	0	3
3	Environmental Chemistry	2	1	3
4	Engineering Mechanics	3	0	3
5	Pakistan Studies	2	0	2
6	Introduction to Computer Programming	1	2	3
	Total	14	3	17

Semester-3

Course No.	Course Title	Lec. - CH	Lab - CH	Total – CH
1	Islamic Studies	2	0	2
2	Anthropology/ Sociology of Development/ Environment and Human Interaction/ Psychology	2	0	2
3	Mathematics – II	3	0	3
4	Fluid Mechanics	3	1	4
5	Thermodynamics	3	1	4
6	Environmental Microbiology	2	1	3
	Total	15	3	18

Semester-4

Course No.	Course Title	Lec.-CH	Lab -CH	Total – CH
1	Environmental Economics	2	0	2
2	Ecological Management / Sustainable Development	2	0	2
3	Mathematics – III	3	0	3
4	Computer Aided Design and Drafting	2	2	4
5	Mechanics of Solids/ GIS & Remote Sensing/ Plumbing Design	3	1	4
6	Electrical Technology	2	1	3
	Total	14	4	18

Semester-5

Course No.	Course Title	Lec. - CH	Lab - CH	Total – CH
1	Water supply and waste water Engineering	3	1	4
2	Numerical Analysis	3	0	3
3	Soil Mechanics	3	1	4
4	Engineering Hydrology	3	1	4
5	Solid Waste Management	3	0	3
	Total	15	3	18

Semester-6

Course No.	Course Title	Lec.-CH	Lab - CH	Total – CH
1	Project Planning & Management	2	0	2
2	Principles of Water and Waste Water Treatment	3	1	4
3	English Communication Skills	2	1	3
4	Environmental Engineering Lab Techniques	2	2	4
5	Elective Course (University Option)	3	0	3
	Total	12	4	16

Semester-7

Course No.	Course Title	Lec. - CH	Lab - CH	Total -CH
1	Water Resources & Irrigation Engineering	3	1	4
2	Water Pollution Control	3	1	4
3	Air & Noise Pollution Control	3	1	4
4	Senior Design Project – I	0	3	3
	Total	9	6	15

Semester-8

Course No.	Course Title	Lec. - CH	Lab - CH	Total - CH
1	Environmental Health & Safety	3	1	4
2	Cleaner Production Techniques	2	1	3
3	Environmental Impact Assessment & Management	2	1	3
4	Energy Resources and Management	3	0	3
5	Senior Design Project – II	0	3	3
	Total	10	6	16

DETAILS OF COURSES

B.E/B.Sc Environmental Engineering

1. COMPUTING

COMPUTER AIDED LEARNING

Objectives:

- *Teach the structure, operation, programming, and applications of computers.*

Contents:

Introduction:

History, classification, basic components, CPU, memory, peripheral devices, storage media and devices, physical and logical storage, data organization, file storage, programs and software, system software, application software, operating systems, programming languages, compilation and interpretation, problem specification, algorithms, flow chart, pseudo code, basic programming techniques, data types and declaration, header file and linkage, variables and constants, arrays, input/output, termination, remark, control structures, branching, conditional structures, repetition and loops, basic library functions, social impact of computer age, computers in office, industry and education.

Lab Outline:

Computation of number system, implementation of Boolean functions, basic machines organization including motherboard, memory, I/O cards, networking devices, use of flow charts, introduction to office tools, overview of different browsers including open-source browsers, introduction to various operating systems, coding, executing and debugging simple programs, implementation of simple control structures, implementation of simple functions, implementation of different function styles.

Books Recommended: (Latest edition where possible)

1. Brian Williams and Stacey Sawyer, "Using Information Technology," Seventh Edition, 2007, McGraw-Hill, ISBN: 0072260718
2. William Stallings, "Computer Organization and Architecture: Designing for Performance," Seventh Edition, 2006, Prentice Hall, ISBN: 0131856448

INTRODUCTION TO COMPUTER PROGRAMMING

Objectives:

- *To learn computer languages,*
- *To enhance skills of computer programming applications.*

Contents:

Introduction: Introduction to computer programming, Program structure and flow charts.

Programming Fundamentals: Arithmetic operations and functions, input/output statements, decision making statements and loop functions and subroutines. Data and Data Files.

Computer Languages: Fundamentals of FORTRAN, Visual BASIC and/or Visual C++ Programming.

Applications: Programming of simple and elementary environmental engineering problems.

Internet: Use of web as an academic tool.

Books Recommended (Latest edition where possible)

1. Gottfried, B.S. Programming with Structured Basics (Schaum Series), McGraw Hill.
2. Steven Holzner , Black Book of C++
3. Evangelos Petroustos, Mastering Visual Basic 6, Sybex Computer Books Inc. USA.

COMPUTER AIDED DESIGN AND DRAFTING

Objectives:

- *To enable students to learn basics of engineering drawing.*
- *To enhance student skills to prepare and understand drawings for environmental engineering application.*

Contents:

Introduction: Need and requirement of drawings for environmental engineering projects. General nature of drawings, components, symbols and nomenclature needed for specific drawings such as architectural, structural, plumbing, electrical, air-conditioning, roads and earth work etc. Drawings at different stages of projects, Elements of perspective drawing.

Types of lines, lettering, dimensioning, drawing instruments, planning of drawing sheet. Types of projections, orthographic projections, plane of projections

Isometric and pictorial projections of solids/machine parts, making of freehand sketches from solid objects and from orthographic projections. Sections of joints, screw thread systems, nuts and bolts, pipe connections, preparation of pipelines and sewer profile (longitudinal section, etc) drawings.

Computer Aided Drawing & Drafting: General and basic know how related to computer aided drafting, e.g. co-ordinate system, drawings setup procedure, basic draw commands, basic edit commands, Layers, creating text and defining styles options, block and drawing import/export options, Cross hatching, save and plot (2D) and isometric drawings.

Practical/Lab. work:

Practicals related to the topics covered in theoretical Section.

Books Recommended: (Latest edition where possible)

1. Engineering Drawing and Graphics by T.T. French, C.J. Vierck, R.J. Foster.
2. Practical Geometry & Engineering Graphics by Abbot.
3. Engineering Graphics by Craft, Meyers & Boyer.
4. M. Chakarborti, Civil Engineering Drawing,
5. Gurcharan Singh, Civil Engineering Drawing, 2nd ed. Malik Book Dept., Lahore
6. George Ormura, Mastering AutoCad 2000, 1st ed. BPB Publisher
7. Boughton, B. Reinforced Concrete Details Manual (Reference Book), Crosby Lockwood Staples Granada Publishing, London

2. **ENGINEERING FOUNDATION**

SURVEYING

Objectives:

- *To enable students to understand theory and practice of land surveying.*
- *To develop skills to use the modern survey instruments.*

Contents:

Introduction: Introduction to land surveying, terminology, instruments used, branches and their application.

Techniques: Chain surveying, theodolite its types, use in traversing and triangulation, tachometry, plane table surveying. Two and three point problems. Computation of areas and volumes by various methods.

Modern Methods in Surveying: Principles of EDM Operation, EDM Characteristics, Total Stations, Field Procedures for Total Stations in Topographic Surveys, Construction Layout Using Total Stations. Global Positioning System-GPS

Leveling and Contouring: Reduction of levels, temporary and permanent adjustments of level, precise leveling methods and applications to contouring.

Field Work: Horizontal and Vertical control, Construction Surveys, Rail Road, Pipelines and other infrastructures. Layout of buildings and structures.

Books Recommended, (Latest edition where possible)

1. Kavanagh, B. Surveying principles and Application, Prentice Hall
2. Irvine, W. Surveying for Construction, McGraw Hill
3. Davis, R.E. Surveying Theory and Practice, McGraw Hill
4. Russel, P.W. and Brinker, C. , Elementary Surveying, Harper Collins
5. James M. Anderson and Edward M. Mikhail, Introduction to Surveying, International Student Edition, McGraw Hill Book Company.
6. Wolf P.R. & Ghilani C. D. Elementary Surveying – An introduction to Geomatics, Prentice Hall.

ENGINEERING MECHANICS

Objectives

- *To understand relationships of forces, statics and dynamics of physical processes.*
- *To develop skills to use the basic principles in engineering applications.*

Contents:

Basic Concepts: Concepts of space, time, mass, velocity, acceleration and force. SI and British Gravitational (BG –formerly FPS) units. Scalar and vector quantities, Newton's laws of motion, law of gravitation.

System of Forces: Resultant and resolution of co-planer forces using parallelogram, triangle and polygon law. Simple cases of resultant and resolution of forces in space. Conditions of equilibrium of co-planer forces, analytical and graphical formulations.

Equilibrium of Rigid Bodies: Free body concept, conditions of support and attachment to other bodies, Support Reactions, Degree of restraint and static determinacy. Statically determinate problems especially of civil engineering importance, Equilibrium of two-force and three-force bodies.

Kinetics and kinematics : Work, energy and power. Virtual work formulation of equilibrium of coplanar force. Potential energy, energy criterion for equilibrium, stability of equilibrium, application to simple cases.

Rigid Bodies: Geometrical properties of plane areas, first moment of area, centroid, second moment of area, principal axes, polar second moment of area and radius of gyration.

Friction: Coulomb's theory of friction. Problems involving friction on flat and curved surfaces.

Books Recommended (Latest edition where possible)

- 1 Hibler, R.C. Engineering Mechanics, Prentice Hall.
- 2 F.L. Singer, Engineering Mechanics, Harper and Row Publisher
- 3 Ferdinand P. Beer and E. Russel Johnston Jr. Vector Mechanics for Engineers

MECHANICS OF SOLIDS

Objectives:

- *To learn basics of material strength.*
- *To enhance skills of utilizing material of appropriate strength for environmental engineering application.*

Contents:

Simple Stress and Strain: Kinds of stresses and strains, Load Extension Diagrams for different Materials, Hook's Law, Moduli of elasticity, Lateral strain, Volumetric Strain, Poisson's Ratio, Thermal stresses and Compound bars.

Stresses in Beams: Theory of simple bending, Moment of resistance and section modulus, Application of flexure formula, Shear Stresses in Beams, Shear Centre, Shear Flow, Unsymmetrical Bending.

Column and Struts: Axially loaded columns, Euler's Treatment, Rankine Gordon Formula for short and intermediate columns, Slenderness Ratio.

Circular Shafts: Theory of Torsion for solid and hollow circular shafts.

Springs: *Open coil springs, closed coil springs, leaf springs.*

Strain Energy: *Strain Energy due to direct loads, force, bending moments and torque, Stresses due to impact loads.*

Practical/Lab. Work:

Practical related to the topic covered in theoretical section.

Books Recommended (Latest edition where possible)

1. Pytel, A. & F.L.Singer, Strength of Material, Harper & row Publishers, New York.

REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM (GIS)

Objectives

- *To introduce different satellites images recorded in different ways and methods of their analysis.*
- *To provide an understanding of Remote Sensing & GIS, their evolution and applications*

Contents:

Introduction to Geoinformatics: Resources of information, Photogrammetric surveying, Aerial and Satellite Photogrammetry.

Global Positioning System (GPS): Fundamentals of Satellite Systems, Navigational and Earth Resources Satellites, Positioning systems (GPS/Galileo) Integrating GPS data in GIS.

Remote Sensing (RS): Physical basis of Remote Sensing, Sensors, Platforms, Resolutions, Image Processing Techniques. Classification and Digital Mapping.

Geographic Information Systems (GIS): Spatial Data types and acquiring considerations. Data models and structures. Projections and transformations. Attribute-based operations, spatial Analysis.

Field and Laboratory Work: Trainings on GPS based surveys, Arc GIS, Arc Info, ERDAS and other software. RS/GIS applications in engineering disciplines.

Books Recommended: (Latest edition where possible)

1. Michael Kennedy (2002), *The Global Positioning System and GIS: An Introduction*, 2nd edition, Taylor & Francis, New York, ISBN-0-415-28608-5
2. Thomas, M. Lillesand & Ralph W. Kiefer (2005), *Remote Sensing and Images Interpretation*, 5th edition, John Wiley & Sons, Inc.
3. Clarke, K. (2004), *Getting started with Geographic Information System*, Prentice Hall, New York, Second Edition ISBN-1879102897
4. Lulla, K and Dessinov, L V, 2000. *Dynamic Earth Environment*
5. *Remote Sensing Observations from Shuttle Mission*. John
6. Wiley and Sons. Inc.
7. Rancez, A Z, 1999. *Remote Sensing for the Earth Sciences*. John
8. Wiley and Sons. Inc.
9. Foody, G M and Curran, P J, 1994. *Environmental Remote Sensing*
10. *from Regional to Global Scales*. John Wiley and Sons. Inc.
11. Murai, S (ed.), 1996. *Remote Sensing Note*, 2nd edition. Japan
12. Association on Remote Sensing, Tokyo.

13. Lillesand, T M and Kiefer, R W *Remote Sensing and Image*
14. *Interpretation*. John Wiley and Sons Inc.
15. Luder D R *Aerial Photographic Interpretation* (latest edition).
16. Bernhardsen, T, 1992. *Geographic Information Systems*. Vivak IT
17. Publishers, Norway.
18. Taylor, D R F, 1991. *Geographic Information Systems, The*
19. *Microcomputer and Modern Cartography*. Pergamon Press, Toronto.

FLUID MECHANICS

Objectives:

- *To learn basics of fluid mechanics.*
- *To enhance skills of utilizing fluid mechanics principles for environmental engineering application.*

Contents:

Introduction: Fluid mechanics, hydrostatics, kinematics, hydrodynamics, Hydraulics, Solids and fluids, liquids and gases, Units and dimensions. Physical properties of fluids, density, specific weight, specific volume, specific gravity, surface tension, compressibility. Viscosity, units of viscosity, measurement of viscosity, Newton's equation of viscosity.

Fluid Statics: Pressure intensity and pressure head, pressure-specific weight relationship, absolute and gauge pressure, measurement of pressure, Piezo-meter, manometer, pressure transducers, Differential manometer and Borden gauge.

Forces all submerged planes and curved surfaces and their applications, buoyancy and Floatation, Equilibrium of floating and submerged bodies.

Fluid Kinematics: Steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow, Path-lines, streamlines and stream tubes. Velocity and discharge, Equation of continuity for compressible and incompressible fluids.

Hydrodynamics: Different forms of energy in a flowing liquid, energy head, Bernoulli's equation and its application. Energy Line and hydraulic grade line, free and forced vortex.

Flow Measurement: Viscometer, manometer, Orifices and mouthpieces, sharp-crested weirs and notches, pitot tube and pitot-static tube, Venturi-meter.

Steady Flow through Pipes: Darcy- Weisbach equation for flow in pipes. Losses in pipe lines, hydraulic grade lines and energy lines. Pipes in series and parallel. Transmission of energy through pipes.

Uniform Flow in Open Cannels: Chazy's and Manning's equations. Bazin's and Kutter's Formula, Most economical rectangular and trapezoidal sections.

Books Recommended:_(Latest edition where possible)

1. Daugherty, R.L., J.B. Franzini and Fenimore, Fluid Mechanics with Engineering Application, McGraw Hill New York
2. Fluid Mechanics by F.M. White, McGraw Hill.
3. Fluid Mechanics by Shames McGraw Hill

SOIL MECHANICS

Objectives:

- *To learn various characteristics of soils*
- *To enhance the knowledge of geotechnical investigation for application in environmental engineering.*

Contents:

Significance. Soil, rock and their types and formation. Physical properties of soil: water content, voids ratio, porosity, degree of saturation, specific gravity, unit weight and their determination, mass-volume relationships.

Soil Classification: Importance of classification tests. Atterberg's limits, grain size distribution, classification systems.

Geotechnical Investigation: Soil exploration, purpose and methods of soil exploration. Probing, test trenches and pits, auger boring, wash boring, rotary drilling, and geophysical methods, soil samplers, disturbed and undisturbed samples. Introduction to geotechnical report writing.

Permeability and Seepage: Darcy's law, factors affecting permeability, laboratory and field determination of permeability, capillary and its effects. Seepage force. Introduction to flow net. Estimation of seepage quantity. Quick sand condition. Sand boiling Filters.

Compaction: Fundamentals, moisture density relationship, compaction standards, factors affecting compaction, field control and measurements of in-situ density. Field compaction equipment.

Consolidation: Mechanics of consolidation, theory of one dimensional consolidation, assumptions and validity, compression index, co-efficient of compressibility,

time factor, coefficient of volume change and degree of consolidation, primary and secondary consolidation. Normal and pre-consolidated soils.

Books Recommended (Latest edition where possible)

1. Donald P. Coduto Geotechnical Engineering (Principles and practices)
2. Whitlow, R., Basic Soil Mechanics, Longman Scientific & Technical
3. Smith, G.N. Elements of Soil Mechanics, Oxford BSP, Professional Books.
4. Smith, G.N. Elements of Foundation Design, Granada Publisher.

WATER POLLUTION AND CONTROL

Objectives:

- *To learn about water pollution and its impacts on the environment.*
- *To learn methods for water pollution control.*

Contents:

Types of water pollutants: Organic and inorganic pollutants; nutrients, pesticides, heavy metals, toxic chemicals, salt, silt, and thermal pollution.

Sources and causes of water pollution: point and non-point sources, contribution of domestic, industrial, agricultural, transport, and mining effluents to water pollution.

Impacts of water pollution: Water pollution and human and ecological health, impacts through food chain.

Water quality: Water quality criteria and requirements, water quality standards for various uses including drinking water, irrigation, recreation etc.

Water pollution control: Source reduction vs end of pipe treatment, water pollution prevention practices and techniques, water treatment

Legislation and instruments for water pollution control: Legislation, regulation and instruments for water pollution control with particular reference to Pakistan

Books Recommended: (Latest Ed. Where Possible):

1. Water pollution control: A guide to the use of water quality management principles, Edited by R. Helmer and I. Hespanhol Published on behalf of UNESCO, WHO and UNEP by E&FN Spon 2-6 Boundary Row, London SE1 8HN, UK ISBN 0419229108

2. Water pollution by Rhonda Lucas Donald
3. Clean Water: An Introduction to Water Quality and Pollution Control by Kenneth M. Vigil
4. Water Supply and Pollution Control by Warren Viessman Jr. and Mark J. Hammer.
5. Water Pollution in India: Law and Enforcement by Bharat Desai.
6. David Krantz and Brad Kifferson, Water pollution and Society.
7. Louis Theodore, Handbook of Environmental Technology, John Wiley Inc.
8. Government of Pakistan and IUCN. 1992. The Pakistan National Conservation Strategy, Islamabad
9. Government of Pakistan, Environmental Policy of Pakistan, Islamabad.

INTRODUCTION TO ENVIRONMENTAL ENGINEERING

Objective:

- *To introduce basic concepts and issues related to the environment*
- *To highlight the professional practices in environmental engineering*

Contents:

- Introduction to environment and factors affecting the environment.
- Global, regional and national environmental issues.
- Global environmental issues; acid rain, global warming, ozone depletion.
- Introduction to national environmental problems related to human wastes, industrial wastewaters and solid wastes, water, air and radiological pollution.
- Population and resource utilization,
- Environmental degradation processes and environmental pollution.
- Effects of pollution on human health and environment.
- Sustainable development, definition and inter-relationship between its components. Strategies for sustainable development.
- Key elements of Pakistan National Conservation Strategy.
- International environmental conventions and treaties.
- Introduction to codes and ethics of environmental engineering
- Review of national and international codes and ethics in environmental engineering
- Relationship between ethics and human rights and their importance in human settlements and societies.

Books Recommended (Latest edition where possible)

1. Principles of Environmental Engineering and Science by Mackenzie L Davis and Susan J Masten, The McGraw-Hill Series in Civil and Environmental Engineering)SBN: 0072350539 / 9780072350531

2. Introduction to Environmental Engineering, by Davis, Mackenzie L. and Cornwell, David A. 1008 pages, 2006
3. National Conservation Strategy of Pakistan (1992), Government of Pakistan
4. Gazette of Pakistan – Environmental Protection Act 1997, Government of Pakistan

3. MAJOR BASED CORE (BREADTH)

WATER SUPPLY AND WASTEWATER ENGINEERING

Objectives:

- *To learn layout and design of water distribution network*
- *To learn design of sewer systems*

Contents:

Water supply and wastewater collection systems. Estimates of water demand and wastewater flows. Water consumption, factors affecting water consumption, variation in water consumption. Fire demand. Sources of wastewater. Wastewater flow rates and variations. Design period. Methods for estimation of design population. Design flows for water supply and wastewater systems.

Water and wastewater quality parameters. Drinking water quality and human health. Water quality guidelines and standards. WHO guideline for drinking water quality.

Water source. Initial investigation for selecting water source. Design and construction of tube wells. Well troubles and their solution. Water collection systems for surface water sources.

Water transmission and distribution system. Components, layouts. Hardy cross method for pipe network analysis. Design of water distribution systems, construction, testing and commissioning of distribution systems. Overhead reservoirs, their function, location and capacity. Different varieties of water supply pipes. Valves and fire hydrants used in water supply systems.

Sewer systems and their layout. Sanitary and storm sewers. Sewer appurtenances. Hydraulics of sewers. Design of sanitary and storm sewers. Design of wastewater pumping stations. Loads on sewers. Sewer pipes and beddings. Layout of sewers.

Books Recommended (Latest edition where possible)

1. Mackenzie L. Davis, David A. Cornwell, Introduction to Environmental Engineering, McGraw-Hill,
2. Terence J. McGhee, Water Supply and Sewerage, 6th edition, McGraw Hill
3. Howard S. Peavy, Environmental Engineering

PRINCIPLES OF WATER & WASTEWATER TREATMENT

Objective:

- *To understand the design principles of water and wastewater treatment systems.*

Contents:

Types of Reactors in environmental Engineering: Batch and continuous flow reactors. Plug flow and completely mixed flow reactors. Completely mixed flow reactors with and without solids recycle.

Unit Operations & Processes: General process flow diagrams of water and wastewater treatment plants.

Water Treatment: Physical and chemical processes for water treatment: Coagulation, flocculation, sedimentation. Filtration, Softening and Disinfection.

Wastewater Treatment: Physical Chemical and Biological wastewater treatment processes. Activated sludge process. Aerated lagoons. Trickling filters and biological towers. Waste stabilization ponds. Biological nitrification and denitrification. Biological phosphorus removal aerobic and anaerobic treatment of biosolids.

Books Recommended (Latest books where possible)

1. Gerard Kiely, McGrawHill International Edition, 1997, Environmental Engineering
2. Metcalf and Eddy, 3rd edition, McGrawHill, Waste Water Engineering

ENGINEERING HYDROLOGY

Objective:

- *To learn about importance of hydrology and its application in environmental engineering*

Contents:

Introduction: Hydrology, hydrological cycle, importance and practical uses of hydrology.

Meteorology: The atmosphere and its composition, Solar radiation as a source of heat, air temperature, relative humidity, dew point, Saturation deficit, Measuring devices of above mentioned parameters, Global climate change.

Precipitation: Types of precipitation, factors necessary for precipitation, measurement of precipitation, interpretation of precipitation data, computation of average rainfall over a basin.

Evaporation and Transpiration: Factors affecting evaporation, measurement of evaporation, evapo-transpiration.

Stream Flow: Water stage and its measurement, selection of site for stage recorder, selection of control and metering section, methods of measurement of stream flow, interpretation of stream flow data.

Runoff & Hydrographs: Factors affecting runoff, estimating the volume of storm runoff, Characteristic of Hydrograph, components of a hydrograph, hydrograph separation, estimating the volume of direct runoff, introduction to unit hydrograph concept, S-curve, Application of probability in determining maxima/minima of discharge, Types of histogram and distribution.

Stream Flow Routing Introduction to floods and its causes, frequency and duration analysis, Reservoir routing, channel routing, Flood Control.

Groundwater: Introduction, sources and discharge of ground water, Water table and confined and unconfined aquifers, groundwater hydraulics, pumping test.

Book Recommended (Latest edition where possible)

1. Warren Viessman, Jr. and Gary L. Lewis, Introduction to Hydrology, 4th Edition
2. R. K. Linsley, Max A. Kohler, and Joseph L. Paulhus, Hydrology for Engineers by (Latest edition)
3. Linsley, R. K., J. Franzini, Water Resources Engineering, McGraw Hill.
4. David, A. Chin, Water Resources Engineering, John Wiley & Sons.

AIR AND NOISE POLLUTION CONTROL

Objectives:

- *To learn about air and noise pollutants and their impacts on the environment.*
- *To learn mitigation techniques for air and noise pollution.*

Contents:

Air Pollution: Sources, causes and control, Air pollution and human health. Stationary and mobile sources. Fuel and engine based air pollution. Air quality standards. Methods used for controlling air borne emissions of gases, aerosols and organic vapors. Legislation and regulation in Pakistan.

Elementary study of dispersion models: Haze, smog, fog etc.

Radioactive pollution: sources, causes and control.

Noise pollution: Sources, causes and control. Fuel and engine based noise pollution Noise quality standards in Pakistan, vehicular exhaust emission, test procedures.

Practical / Lab. work:

- Practicals related to the topics covered in theoretical section.
- Field Visits

Books Recommended Books: (Latest edition where possible)

1. Air Pollution Control Engineering by N.D. Nevers (1995) McGraw Hill.
2. Air Pollution by H.C. Perkins MC Graw Hill
3. Noise Pollution by Tripathy, Debipras

SOLID WASTE MANAGEMENT

Objective:

- *To learn about various techniques used for solid waste management.*

Contents:

Sources (Municipal, Industrial, Hospital, Nuclear, etc), Types, Generation, Compositions, Properties: Physical, Chemical and Biological. Regulatory compliance. Waste minimization and recycling. Waste collection, transfer, scavenging, transport and disposal.

Disposal and Management Techniques:

Composting and its types , Incineration and its impacts, Immobilization, Vitrification, pyrolysis. Landfills Types, Methods, Siting and design

considerations, Control of landfill leachate & gases – Environmental monitoring System for Landfill sites.

Sources and Nature of Hazardous Waste - Impacts on Environment
Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure.

Practical/Lab work:

Practicals related to the topics covered in theoretical Section.

Books Recommended (Latest editions where possible)

1. Integrated Solid Waste Management, by John Tchano baglus, McGraw Hill
2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall, 2000.
3. Hazardous and Radioactive Waste Treatment Technologies, Handbook by Chang, H. Oh, CRC Press-2001

Reference/Books:

1. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985

ENVIRONMENTAL ENGINEERING LABORATORY TECHNIQUES

Objective:

- *To learn about various techniques used for analysis of different parameters affecting environment.*

Contents:

Introduction to standard methods of analysis. Quality assurance and quality control programs. Collection and preservation of samples. Principles and methods for monitoring and discrete/composite sampling of environmental media, including surface water, ground water, and wastewater. Gravimetric and volumetric methods of analysis for main groups of pollutants. Environmental significance and determination of water quality parameters like solids, DO, BOD, COD, hardness, alkalinity, turbidity, Kjeldahl nitrogen, and total and faecal coliforms according to the Standard Methods. Data management methods-data quality objectives, data presentation and interpretation. Theory and principles of instrumental techniques such as liquid chromatography, AAS, FTIR, spectrophotometry, radiometry, polarimetry, gas chromatography, HPLC, and Oil analyses.

Application of selected instrumental techniques for the determination of pesticides, toxic / radio-toxic metals and other trace organics. Use of field instruments and test kits (e.g. Detection and Measurement of radioactivity by instruments, Track detectors, Gaseous ion detectors, scintillation detector, Thermoluminescent detectors, semiconductors) are also covered.

Books Recommended (Latest edition where possible)

1. American Society of Public Health Engineers Standard Methods of examination of water and wastewater
2. MFL Annunziata Academic Press Inc New York, Handbook of radioactivity Analysis, 1998
3. Radiation detection and measurements by Glenn, F. Knoll, 3rd Ed. 1999

4. MAJOR BASED CORE (DEPTH)

ENVIRONMENTAL HEALTH AND SAFETY

Objective:

- *To enhance awareness about the principles of environmental health and safety*

Contents:

Principles of public health; communicable & non communicable water borne diseases, food borne, air borne and sanitation related diseases and control measures. Industrial- Nuclear hygiene and safety, accident prevention and elimination plans, fire protection techniques, safety equipments, Occupational health and safety in Pakistan, Labour code of Pakistan (1986), Industrial-Nuclear and occupational rules and regulations in Pakistan, Agricultural Pesticides Rules, 1973, Agricultural Pesticide Ordinance, 1971, ISO-14000, OHSAS-18001, Pakistan Nuclear Regulatory Authority (PNRA) Regulations Pak/904 "Regulation on Radiation Protection-2004"

Introduction to the principles of Toxicology as applied to environmental Engineering. Health hazards and toxic effects of chemicals, radioactivity; Transport, storage & use of toxic chemicals-radio nuclides, Occupational health programs

Books Recommended: (Latest edition where possible)

1. Salvata (1992) Wiley Interscience, Environmental Engineering. & Sanitation.
2. S. Caeneross (1993) Wiley Interscience, Environmental Health Engineering.

3. K.F.H. Murrell, Chapman & Hall International (latest edition), Safety for Industry Economics

WATER RESOURCES & IRRIGATION ENGINEERING

Objective:

- *To enhance the knowledge of water resources management and irrigation*

Contents:

Water Resources: Planning and development of water resources projects. Domestic, Industrial, Agricultural and other water usages, Water resources in Pakistan.

Irrigation: Definition and types of irrigation. Merits and demerits of irrigation, Indus Basin Irrigation System (IBIS).

Indus Water Treaty and Water Accord 1991 (IRSA).

Canal Irrigation: Elementary concept about canal head works, selection of their site and layout, weirs and barrages, various components and functions. Measures adopted to control silt entry into canals, silt ejectors and excluders. Design of weirs on permeable foundations, sheet piles and cut off walls. Design of irrigation channels, Kennedy's and Lacey's Theories. Rational methods for design of irrigation channels. Comparison of various methods. Computer Aided design of irrigation channels.

Dams, Barrages and Headworks: Classification of Dams. Sedimentation control. Canal head regulators, falls, flumes, canal outlets. Cross drainage works: types and functions. Canal lining. Maintenance of irrigation canals. Monitoring of flows-telemetry system.

Irrigated Agriculture: Irrigation methods and practices. Irrigation scheduling. Management of irrigation systems, participatory irrigation management.

Water logging and salinity: Causes and effects of water logging, reclamation of water logged soils. Drains and tube wells. Causes and effects of salinity and alkalinity of lands in Pakistan.

Drainage: Definition, Land reclamation, Surface Drainage, Subsurface Drainage, Cross-drainage structures, Disposal of drainage effluents.

Books Recommended: – (Latest edition where possible)

1. Sharma, R.K. and T.R.Sharma, Irrigation and Drainage, Vol-I to V. Oxford and IBH Pub. Co.

2. Linslay, R.K. and Joseph, B.F. Water Resources Engineering, McGraw Hill.
3. Siddiqui, Iqtidar H., Irrigation and Drainage Engineering, Oxford University Press

ENVIRONMENTAL IMPACT ASSESSMENT

Objectives:

- *To provide basic knowledge of environmental impacts of development projects and their mitigation*
- *To prepare Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) statements and environmental management Plans (EMPs)*

Contents:

- Introduction to Environmental Impact Assessment: IEE & EIA
- Role of governments and EIA legislation
- Environmental impact assessment process
- Screening and scoping techniques.
- Importance of baseline data.
- Impact identification methods and techniques.
- Remedial measures.
- Environmental Management Plan (EMP)
- Role of public consultation and participation in EIA Process
- Environmental impact statement.
- Impact assessment methodologies (Adhoc, checklists, Matrices, Networks, Overlays, GIS techniques, simulation models, cost-benefit analysis)
- Environmental impact assessment and management of selective development projects- Case Studies

Books Recommended: (Latest Ed. Where possible)

1. Wood, C, 1995. *Environmental Impact Assessment (A Comparative Review)*. Longman Scientific and Technical. Longman House. Burnt Hill, Harlow Essex. UK.
2. Petts, J and Eduljee, G, 1994. *Environmental Impact Assessment for Waste Treatment and Disposal Facilities*. John Willey & Sons Inc. UK.
3. North K, 1997. *Environmental Business Management: An Introduction*, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Khan M I, Tahir B A, and Akhtar N., 2004. *Integrated Environmental Management: Urban and Rural*, Allama Iqbal Open University.
5. Asian Development Bank. *A Manual for Environmental Impact*

Assessment.

6. GoP, 2000, IEE/EIA Regulations, Ministry of Environment, Government of Pakistan.

CLEANER PRODUCTION TECHNIQUES

Objective:

- *To impart know-how for resource optimization, pollution control and corporate competitiveness*

Contents:

- Cleaner production and Sustainable development;
- Cleaner production principles and phases;
- Cleaner Production Plans and strategies for implementing cleaner production plans
- Cleaner Production and Eco-efficiencies;
- Environmental management system;
- Closed loop operations;
- Detailed chemical/material flow analysis;
- Renewable energy resources;
- Life cycle design and impact assessment;
- Waste minimization; Reuse of waste products; specific examples from industry where the methods of cleaner production have been applied.

Books Recommended:

1. Identification of Cleaner Production Improvement Opportunities by [Kenneth L. Mulholland](#)
2. Promoting cleaner production in developing countries the role of development co-operation, OECD Publications
3. Environmental Management Systems and Cleaner Production, by Hillary Ruth (Edit)
4. Engineer's Guide to Cleaner Production Technologies by [Paul M. Randall](#)
Technomic Publishing Co., Inc. ISBN-10: 1566764238
5. Cleaner Production: Global Status 2002, United Nations Environment Programme,
<http://www.emcentre.com/cpglblstatus/>

ENERGY RESOURCES MANAGEMENT

Objective:

- *To enhance the knowledge of conventional and renewable energy resources and their management*

Contents:

Energy and Power:, Forms of Energy: Mechanical energy, electrical energy, chemical energy, nuclear and thermal energy.

Perspectives of world & local energy production and consumption, types of energy resources (Renewable & Non Renewable, Conventional & Non conventional, Commercial & Non Commercial).

Economic incentives of energy resources theory and application of different energy resources (i.e. Biomass, direct combustion of biomass, ii. Solar energy, iii. Wind energy technology, iv. Energy from Hydropower, v. Geothermal and other natural sources, vi. Fossil fuels).

Environmental impacts of energy production and utilization.

Importance of energy conservation

Books Recommended (Latest edition where possible)

1. Energy and Environment, Willey, 2nd Ed. 2005
2. Energy, environment and Climate, Richard Wolfson, W. W. Norton, 1st Ed., 2008.
3. Renewable energy, Bent Sorensen
4. Environmental Science, Richard T. Wright, 9th Ed., 2004
5. John & Smith, Renewable Energy Resources
6. John Twidell, Renewable Energy Resources.

5. INTER-DISCIPLINARY ENGINEERING BREADTH (ELECTIVE)

ELECTRICAL TECHNOLOGY

Objectives:

- *To learn basic knowledge of electrical technology.*
- *To broaden engineering sense of environmental engineers.*

Contents:

Electrical Elements and Circuits: Electric current, voltage, power and energy, Ohm's law, inductance, capacitance, Kirchoff's laws. Introduction to node voltage and loop current methods, AC single and polyphase system, DC machines, AC Synchronous Machines, AC Induction Machines, Transformers, and Converting Machines.

Power Plant Installations and Distribution System: Power Systems layout, generation, transmission, distribution and utilization of electric power, Introduction to domestic electrification.

Electronics: Diode. Transistor and simple rectifier circuit. Principles of House wiring and Industrial wiring, illumination. Electrical know how related to experimental design instrumentations like corrosion rate measurements, strain gauges, LDT's, LVDT's. etc.

Books Recommended: (Latest edition where possible)

1. Schaum's Series, Electric Circuits, Basic Electricity
2. Chapman, Electric Machinery Fundamentals
3. Theodore Wildi, Electrical Power Technology

THERMODYNAMICS

Objectives:

- *To learn basic knowledge of thermodynamics.*
- *To study temperature dependent processes in environmental engineering.*

Contents:

Basics of Thermodynamics: The system, working substance, heat and work, state and properties, temperature scales, processes and cycles. PV diagram, Internal energy, specific heats. Ideal gas laws. Equations of state, first law of thermodynamics, system and control volume concept. Application

of processes. Second law of thermodynamics and its consequences, reversibility, heat engines, thermal efficiency of reversible and irreversible engines, the Carnot cycles, internal combustion engines and their environmental impacts. Available and unavailable energy, isentropic process, enthalpy-entropy diagram.

Physical Properties of Steam: The formation of steam, the triple point quality of steam, sub-cooled liquid, enthalpy of steam. Steam tables, P-V diagram for steam, the critical point, behavior of vapor in different thermodynamic processes.

Air Standard Cycles: Otto, Diesel, dual Brayton, Ericsson, Sterling cycles and their applications.

Properties of Mixtures: Dalton's law and the Gibbs Dalton law, Volumetric analysis of gas mixtures, molar mixture and Specific gas constants.

HAVC Systems: Types, principles and their impacts on the environment

Practical/Lab. Work:

Practical related to the topic covered in theoretical section.

Books Recommended: (Latest edition where possible)

1. T.D Eastop and MaConkey, Applied Thermodynamics for engineering
2. Rayner Joel, Technologist Basic Engineering Thermodynamics
3. G.F.C.Rogers and Y.R. Mayhew Engineering Thermodynamics, Work and Heat Transfer
4. Y.A. Gengel and M.A. Boles, Thermodynamics, An Engineering Approach

Part-2

Non-Engineering Courses

1. HUMANITIES

ENGLISH-I

Functional English

Objectives:

To enhance language skills and develop critical thinking

Course Contents:

Basics of Grammar
Parts of speech and use of articles
Sentence structure, Active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening

To be improved by showing documentaries/films carefully selected by subject teachers)

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. Functional English

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

ENGLISH-II

Technical writing and presentation skills

Objectives:

To enhance language skills and develop critical thinking

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

1) Presentation Skills

2) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

COMMUNICATION SKILLS

Objectives:

To enable the students to meet their real life communication needs

Paragraph writing

Practice in writing a good, unified and coherent paragraph

Essay writing

Introduction

CV and job application

Translation skills

Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills

Letter / memo writing and minutes of the meeting, use of library and internet resources

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: Documentaries to be shown for discussion and review

Recommended books:

Communication Skills

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

- 1) Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 45-53 (note taking).
- 2) Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
- 3) Study Skills by Richard Yorke.

ISLAMIC STUDIES

(Compulsory)

Objectives:

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Contents:

INTRODUCTION TO QURANIC STUDIES

- Basic Concepts of Quran
- History of Quran
- Uloom-ul -Quran

STUDY OF SELLECTED TEXT OF HOLLY QURAN

- 1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

STUDY OF SELLECTED TEXT OF HOLLY QURAN

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

SEERAT OF HOLY PROPHET (S.A.W) I

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

SEERAT OF HOLY PROPHET (S.A.W) II

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina
3. Important Lessons Derived from the life of Holy Prophet in Madina

INTRODUCTION TO SUNNAH

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

SELLECTED STUDY FROM TEXT OF HADITH

INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

ISLAMIC CULTURE & CIVILIZATION

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

ISLAM & SCIENCE

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quranic & Science

ISLAMIC ECONOMIC SYSTEM

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

POLITICAL SYSTEM OF ISLAM

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

ISLAMIC HISTORY

- 1) PERIOD OF KHLAFT-E-RASHIDA
- 2) PERIOD OF UMMAYYADS
- 3) PERIOD OF ABBASIDS

SOCIAL SYSTEM OF ISLAM

- 1) BASIC CONCEPTS OF SOCIAL SYSTEM OF ISLAM
- 2) ELEMENTS OF FAMILY
- 3) ETHICAL VALUES OF ISLAM

REFERENCE BOOKS:

- 1) Hameed ullah Muhammad, "**Emergence of Islam**", IRI, Islamabad
- 2) Hameed ullah Muhammad, "**Muslim Conduct of State**"
- 3) Hameed ullah Muhammad, "**Introduction to Islam**"
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "**An Introduction to the Study of Islamic Law**" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "**Principles of Islamic Jurisprudence**" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "**Muslim Jrisprudence and the Quranic Law of Crimes**" Islamic Book Service (1982)
- 8) H.S. Bhatia, "**Studies in Islamic Law, Religion and Society**" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "**Introduction to Al Sharia Al Islamia**" Allama Iqbal Open University, Islamabad (2001)

PAKISTAN STUDIES

Introduction / Objectives

Objectives

- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Contents:

1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism

- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and Geo-Physical features.

2. **Government and Politics in Pakistan**

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

3. **Contemporary Pakistan**

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

Books Recommended

- Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
- Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
- S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
- Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
- Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
- Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
- Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
- Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
- Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
- Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
- Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
- Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.

- Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
- Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

ANTHROPOLOGY

OR

SOCIOLOGY OF DEVELOPMENT

OR

ENVIRONMENT & HUMAN INTERACTION

OR

PSYCHOLOGY

ANTHROPOLOGY

Objective:

- *To introduce anthropological concepts and research techniques for promoting participation of major groups in environmental management*

Contents:

- Introduction to cultural anthropology and its relationship with other social sciences
- Cultural and political organization and resolution of conflicts
- Anthropological research methods with special reference to participant observation
- Participatory management: a new paradigm, concepts and philosophy, historical perspectives; models of participatory management in South Asia;
- Participatory approaches to environment and development;
- A model for urban development “orangi pilot project”; a case study
- Participation of major groups: women, youth and others in the management of various types of ecosystems

Recommended Books:

1. Chambers R, 1997. *Whose Reality Count Putting the First Last*, Intermediate Technology Publications.
2. Shepherd A, 1998. *Sustainable Rural Development*, St. Martin Press, Inc.
3. Adamson, Hoebel and Everett L., Frost, 1979, *Cultural and Social Anthropology*, McGraw Hill,
4. Burkey, S, 1993, *People First, A guide to self-reliant participatory rural*

- development*, Zed Books, London & New York,
5. Dr. Khan M I, Tahir B A, Amir S, and Akhtar N, 2004. *Towards Participatory Management*, Allama Iqbal Open University.36 Curriculum Division .

SOCIOLOGY AND DEVELOPMENT

Objectives:

The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from sub-ordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

Contents:

1. Introduction to Sociology

- 1.1 What is sociology?
- 1.2 Nature, Scope, and Importance of Sociology
- 1.3 Social Interactions
- 1.4 Social Groups
- 1.5 Social Institutions

2. Culture and Related Concepts

- 2.1 Definition of Culture
- 2.2 Types of Culture
- 2.3 Elements of Culture
- 2.4 Role of Culture in Organization
- 2.5 Socialization and Personality

3. Interpersonal Relations

- 3.1 Interpersonal Behaviour
- 3.2 Formation of Personal Attitudes
- 3.3 Language and Communication
- 3.4 Motivations and Emotions
- 3.5 Public Opinion

4. Social Stratification

- 4.1 Factors of Social Stratification
- 4.2 Caste and class
- 4.3 Power, Prestige, and Authority
- 4.4 Social Mobility
- 4.5 Migration

5. Human Ecology

- 5.1 Ecological Processes
- 5.2 Ecosystem and energy
- 5.3 Ecosystem and Physical Environment
- 5.4 Solid Waste Disposal
- 5.5 Pollution

6. Population Dynamics

- 6.1 World Population Growth and Distribution
- 6.2 Population Dynamics in Pakistan
- 6.3 Causes and Consequences of Urbanization
- 6.4 Population Policy in Pakistan
- 6.5 Population and Development

7. Community Development

- 7.1 Meaning, Scope, and Subject Matter of Community Development
- 7.2 Processes of Community Development
- 7.3 Community Development Programs in Pakistan
- 7.4 Community Organization and Related Services
- 7.5 Cooperation and Conflict in Community Development

8. Deviance and Crime

- 8.1 Crime as a Social and Cultural Phenomenon
- 8.2 Crime and Social Organization
- 8.3 Organized Crime
- 8.4 Culture Based Crime
- 8.5 Economics of Crime

9. Sociology of Change and Development

- 9.1 What is Social Change and Development?
- 9.2 Dynamics of Social Change
- 9.3 Role of NGOs in Development
- 9.4 World System and Development
- 9.5 Gender and Development

Recommended Readings

- 1) Allport, G. W. (1985). *The Historical Background of Modern Social Psychology*. New York, Random House.
- 2) Bernard, A. and T. Burgess (2004). *Sociology*, Cambridge University Press.
- 3) DuBrin, A. J. (2007). *Human Relations: Interpersonal Job Oriented Skills*. New York, Prentice Hall.
- 4) Gardezi, H. N., Ed. (1991). *Understanding Pakistan: The Colonial Factor in Societal Development*. Lahore, Maktaba Fikr-o-Danish.
- 5) Hafeez, S. (1991). *Changing Pakistan Society*. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).

- 6) Jones, G. W. (2005). "Why are Population and Development Issues not Given Priority?" *Asia-Pacific Population Journal* **20**(1).
- 7) Macionis, J. J. (1999). *Sociology 7th Edition*, National Book Foundation, Islamabad
- 8) Maser, C. (1997). *Sustainable Community Development: Principles and Concepts*. Florida St. Lucie Press.
- 9) Nelson, N. and S. Wright (1995). *Power and Participatory Development: Theory and Practice*. London, Intermediate Technology Publications.
- 10) Syed, S. H. (2003). *The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy*. Islamabad, UNESCO: 1-30.
- 11) Utton, A. E. (1976). *Human Ecology*, West View Press.
- 12) Webster, A. (1990). *Introduction to Sociology of Development*. London, Nacmillan Education Ltd.
- 13) Weiss, A. M. (2001). *Power and civil society in Pakistan*, Oxford University press.

UNDERSTANDING PSYCHOLOGY AND HUMAN BEHAVIOUR

Contents:

1. What is Psychology?
2. Nature, Scope and Application with Special Reference to Pakistan
3. Different Schools of Psychology
4. Methods of Psychology
5. Learning
6. Intelligence and Artificial Intelligence
7. Personality and its Assessment
8. Understanding Maladjustive Behaviour
9. Positive Emotional States and Processes
10. Stress Management and Anger Management

Books Recommended

1. Atkinson R.C., & Smith E.E. (2000), Introduction to Psychology (13th ed.), Harcourt Brace College Publishers.
2. Fernald, L.D., & Fernald, P.S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
3. Hergenhahn, B.R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.

4. Goodwin, C.J, (2000) *Research in Psychology: Methods and Design*, (3rd ed.), New York: John Wiley & Sons.
5. Synder, C.R., & Lopez, S.J. (2007) *Positive Psychology*, USA, Sage Publications.
6. Allen, B.P. (1997), *Personality Theories: Development, Growth and Diversity*, (2nd Ed.), Boston: Allyn & Bacon.
7. Cohen, R.J., & Swerdlik, M.E. (2005) *Psychological Testing & Assessment* (6th ed.), New York: McGraw-Hill.
8. Corcini, R., (2000). *Current Psychotherapies*. London: Thompson & Co Publishers.
9. Comer, R.J. (2004). *Abnormal Psychology*, USA: Freeman & Company.
10. Schwartz, B., Wasserman, E., & Robbins, S. (2002), *Psychology of Learning and Behaviour*, 5th Ed. Norton and Company.

2. MANAGEMENT

ENVIRONMENTAL ECONOMICS

Objectives:

- *To introduce the basic concepts of environmental economics*
- *To enhance the knowledge of economic analysis*

Contents:

- Introduction to environmental economics.
- Natural resource accounting and valuation of environment; cost benefit analysis, discounting and present value of net benefit.
- Efficient and optimal use of natural resources.
- Economic benefits of non-renewable and renewable resources.
- Pollution control, targets and economic instruments.
- Case studies

Books Recommended: (Latest edition where possible)

1. Chapman, J L and Reiss, M J, 1992. *Ecology (Principles and applications)*. 1st ed. Cambridge University Press UK.
2. Odum, E P, 1971. *Fundamentals of Ecology*. 3rd ed. Saunders Company Philadelphia, USA.
3. Moles, M C J, 1999. *Ecology (Concepts and applications)*. 1st ed. WCB/McGraw-Hill New York, USA.
4. Slingsby, D and Cook, C, 1986. *Practical Ecology*. 1st ed. McMillan Education Ltd. UK.
5. Tietenberg, T, 1996. *Environmental and Natural Resource Economics*. 4th ed. Harper Collins Publishers.
6. Perman, R, Ma, Y, McGilvray, J, 1996. *Environmental and Natural*

- Resource Economics*. Longman, London and New York.
7. James R K, 1998. *The Economic Approach to Environmental and Natural Resources*. Harcourt Brace College Publishers.
 8. Hanley, N, J F Shogren and B White, 2002, *Environmental Economics in theory and practice*, Palgrave Macmillan

ECOLOGICAL MANAGEMENT

Objective:

- *To provide basic concepts of ecology and various methods & techniques for economics analysis of the natural resources and the environment*

Contents:

- Basic concepts in ecology
- Structure of ecosystem,
- Energy and material flow within ecosystem. Succession: (only basic concepts). Ecosystem productivity , food webs and food chains
- Types of ecosystems and their management
- Biodiversity and ecological sustainability
- Nutrient cycles and Eutrophication
- Populations / communities and their dynamics and interaction.
- Species, and extinction,
- Human as keystone species, effects of human activities on ecosystem;

PROJECT PLANNING AND MANAGEMENT

Objective:

- *To learn about importance of planning and management of projects and its applications in environmental engineering*

Contents:

Introduction to project planning & management.

Relationship of development with environment.

Project planning and cost estimation: Preparation of feasibility reports. Rough cost and detailed estimates for environmental engineering projects including preparation of bill of quantities (B.O.Q). Scheduled and non-scheduled rates. Analysis of rates.

Project approval processes in Pakistan

Introduction to contracting and tendering.

Critical path method (CPM). Principle and use of CPM in environmental projects. Manual versus computer analysis of critical path methods,

Project Planning, Scheduling and Controlling: Scheduling resources, Delivering Materials, Scheduling manpower; Financing the project, Job layout, Project control during construction, keeping equipment records, Project supervision. Construction Cost Control, Cost Control records. Use of computer software in project management. Introduction to claims and conflict resolution: escalation, indexation, arbitration and litigation.

Books Recommended: (Latest edition where possible)

1. A Guide to the Project Management Body of Knowledge, Third Edition (PMBOK Guides) by Project Management Institute
2. Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold, Ph.D. Kerzner
3. Fundamentals of Technology Project Management by Colleen Garton
4. Project Management Case Studies by Harold, Ph.D. Kerzner
5. The Art of Project Management (Theory in Practice (O'Reilly)) by Scott Berkun

3. NATURAL SCIENCES

MATHEMATICS-I

Objective:

- *To learn fundamentals of mathematics, calculus and analytical geometry*

Contents:

APPLIED CALCULUS/MATH-I

CH (3+0)

Complex Numbers: Basic Operations, Graphical Representations, Polar and Exponential Forms of Complex Numbers, De'Moivre's Theorem with Applications.

Functions: Hyperbolic Functions and their Graphical representation, Hyperbolic and Trigonometric identities and their relationship, Exponential Functions.

Differentiation: Differentiation and Successive Differentiation and its Application to Rate, Speed and Acceleration, Leibnitz's Theorem and its Applications, Equations of Tangents and Normals, Curvature, Radius and Centre of Curvature, Maxima and Minima of Function of One Variable and its Applications, Convexity and Concavity, Points of Inflexion, Concept of Infinite Series, Taylor's and McLaurin's Series and Expansion of Functions, Errors and Approximations and Limiting Values of Functions.

Partial Differentiation: Partial Differential Coefficient and Chain Rule, Partial Differentiation of an Implicit Function, Total Differential, Euler's Theorem, Applications to Small Errors and Approximations, Statement of Taylor's Theorem of Two Independent Variable and its Applications.

Integral Calculus: Standard Integrals, Function of a Linear Function, Integration by Substitution, by Partial Fractions and by Parts, Integration of Trigonometric Functions, Definite Integrals and their Properties and Reduction Formulae, Curve Tracing in Rectangular and Polar Coordinates.

Integration Applications: Volumes of Solids Of Revolution, Centroid of a Plane Figure, Centre of Gravity of a Solid of Revolution, Lengths of Curves, Surface Revolution, Rules of Pappus, Moment of Inertia, Radius of Gyration, Parallel Axes Theorem, Perpendicular Axes Theorem, Second Moment of Area, Composite Figures, Centres of Pressure and Depth of Centre of Pressure.

Analytical Solid Geometry: Rectangular Co-ordinate Systems in Three Dimensions, Direction Cosines, Plane (Straight Line) and Sphere.

Books Recommended

1. Schaum's series, Calculus, Schum's Series(Latest Edition)
2. Schaum's series, Complex, Schum's series, (Latest Edition)
3. Antom, H. Calculus and Analytic Geometry, Johney Wiley and Sons. (Latest Edition)
4. Talpur, Calculus and Analytic Geometry, Ferozsons(Latest Edition)
5. Yousuf, S.M. Mathematical Methods, Ilmi Kutab Khana(Latest Edition)

MATHEMATICS-II

Objective:

- *Teach the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.*

Contents:

Introduction to functions, introduction to limit, derivatives and their applications, integral calculus with applications, vector algebra, vector calculus, introduction to analytical geometry, straight line in R^3 , planes, cylindrical and spherical coordinates, surfaces, cylinders and cones, spheres, spherical trigonometry.

Book Recommended:

1. George B. Thomas and Ross L. Finney, "Calculus and Analytic Geometry," Ninth Edition, 1995, Addison-Wesley, ISBN: 0201531747.
2. George F. Simmons, "Calculus with Analytic Geometry," Second Edition, 1996, McGraw-Hill, ISBN: 0070576424.
3. Gerald B. Folland, "Advanced Calculus," First Edition, First Edition, 2002, Prentice Hall, ISBN: 0130652652.
4. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, "Calculus," 2002, Prentice Hall, ISBN: 0130918717

MATHEMATICS –III

Objectives:

- *To introduce basic concepts and techniques of statistical analysis*
- *and their application in environmental engineering*
- *To learn and use the advance mathematical techniques for solving*
- *differential equations*

Contents:

- **Statistics:** Frequency distribution, histogram, polygon. Measures of dispersion: Mean, median, mode, standard deviation, variance, Correlation, rank correlation. Lines of regression, least square method, Probability. Theorems of addition and multiplication.
- **Complex number:** Argand diagram, de Moivre's theorem, hyperbolic and inverse hyperbolic functions.
- **Laplace transforms:** definition, linearity property, first and second shifting property, unit step function, derivative of Laplace transform, integration of Laplace transform, convolution theorem, inverse Laplace transform with all properties, applications to the solutions of ordinary differential equations, Wave, heat and Laplace equations. Solution of partial differential equation by Laplace transform.
- **Fourier series:** definition, periodic function, Euler's formulae, Fourier series of circular limits, Fourier series of arbitrary limits, Fourier series of sin and cosine functions, even and odd functions, complex form of Fourier series. Application of Fourier series.

Books Recommended: (Latest edition where possible)

1. Mathematical method, by S.M Yousif.
2. Advance Engineering by B.S. Grawal.
3. Ervin and Kreyszig, E. Advanced Engineering Mathematics, John Wiley and Sons, (Latest Edition).
4. Speigal M. R., Theory and Problems of Laplace Transforms, Schaum's Outline Series.

NUMERICAL ANALYSIS

Objective:

- *To introduce various techniques for solving Linear and Non-linear equations using various numerical methods*

Contents:

- **Solution of Non-Linear Equations:** Simple iteration, Bisection method, Newton's method, Secant method, Method of false position.
- **Finite Differences:** Difference operations and tables, differences of polynomials, Newton's and Gauss interpolating technique for equally spaced data, simple theorems on divided differences, Newton's formulation for unequal intervals, Lagrange's formulation of interpolation, numerical differentiation, curve fitting by the method of least squares.
- **Numerical Integration:** Review of integration concept and their physical significance for Engineering, Trapezoidal and *Simson's* rule numerical integration techniques.
- **Solution of Linear Simultaneous Equations:** Jacobi's method, Gauss-Seidel method, Sparse matrices, Solution of differential equations, Euler and modified Euler methods, Runge Kutta and Kutta Merson methods.
- **Eigen-values and Eigen-vectors:** Iterative and transformation methods, Eigen-values of tri-diagonal matrix.
- **Solution of Polynomial Equations:** Polynomial equations, finding initial approximations and complete solution of polynomial regression analysis.

Books Recommended: (Latest Edition Where Possible)

1. Complex Variables by Murray R. Spiegel, Schaum Series
2. Numerical Analysis by Scheid, Schaum Series

APPLIED PHYSICS

Objective:

- Teach the fundamentals of classical physics including the electrostatics, electrodynamics, solid-state physics, optics, and thermodynamics in relation to the cooling of electronics

Contents:

Electrostatics: Coulomb's law, electric field and potential, capacitance, dielectrics. Electrodynamics: Magnetic field and force, sources of magnetic field, electromagnetic induction, inductance. Solid-state physics: Crystal lattices, unit cells, energy bands, allowed and forbidden states, conductors, semiconductors, insulators. Semiconductors: Composition, purity, n - and p -type materials, carrier properties and distribution. Carrier action: Diffusion, drift, generation, recombination. Conductivity, mobility, p - n junction diode, diode curve, forward-biased diode, reverse-biased diode, bipolar junction transistor and its biasing, MOSFET and its biasing, Hall effect. Optics: Optical absorption, photo-luminescence, photoconductivity, photoelectric effect, lasers, superconductivity. Heat and Thermodynamics in relation to cooling of electronics.

Lab Outline:

Electric fields, Gauss' law, electric potential, capacitance and dielectrics, current and resistance, magnetic fields, sources of magnetic field, Faraday's law, inductance, direct current circuits, alternating current circuits, diode characteristics, transistor characteristics nature of light, geometric optics, laws of geometric optics, interference of light waves, diffraction, polarization.

Books Recommended:

1. David Halliday, Robert Resnick, and Jearl Walker, "Fundamentals of Physics," Seventh Edition, 2005, John Wiley & Sons, ISBN: 0471465097.
2. Arthur Beiser, "Schaum's Outline of Applied Physics," Fourth Edition, 2004, McGraw-Hill, ISBN: 0071426116

ENVIRONMENTAL CHEMISTRY

Objective:

- *To develop know how of chemistry and its application in environmental engineering.*

Contents:

- Introduction to environmental chemistry.

- Basic concepts of:
 1. general chemistry,
 2. physical chemistry,
 3. equilibrium chemistry,
 4. organic chemistry,
 5. biochemistry,
 6. photochemistry and
 7. colloidal chemistry
 8. nuclear chemistry

- Applications of chemistry in resolving environmental problems
- Soil chemistry and environmental contaminants: Pesticides and herbicides, PCBs, PAHs and dioxins, heavy metals and other chemical pollutants.
- Acids and bases: pH diagrams, pH buffers;
- Carbonate chemistry: carbonate System
- Alkalinity and acidity
- Precipitation and dissolution
- Solubility product, factors affecting solubility;
- Oxidation-reduction reactions

Books Recommended: (Latest Ed. Where Possible):

1. Clair N. Sawyer, Perry L, McCarly & Geve F Partern, *Chemistry for Environmental Engineering*. McGraw-Hill, Inc.
2. Harrison R M, De Mora S J, *Introductory Chemistry for the Environmental Sciences*, Cambridge Environmental Series No. 17, Macmillan Press Ltd.
3. [Brimblecombe](#), P, [T. D. Jickells](#) T.D, [Liss](#), P. S, *An Introduction to Environmental Chemistry*.
4. Stumm, Werner and James J. Morgan, *Aquatic Chemistry, Chemical Equilibria and Rates in Natural Waters*, John Wiley and Sons, Inc, [ISBN 0-471-51185-4](#).
5. Baird, C. *Environmental Chemistry*, Freeman: New York, 1995.

ENVIRONMENTAL MICROBIOLOGY

Objective:

- *To develop basic understanding of Microbiology as related to water, waste water, soil and food.*
- *To understand application of microbiology in reducing/elimination of environmental pollution.*

Contents:

- Basics concepts in microbiology and their application in environmental engineering.
- Microbial classification, growth and nutrition. Influence of environment on growth including measurement of growth, DNA structure and replication, protein synthesis.
- Energy mechanism in microbial metabolism
- Cell- structures' and characterization; enzymes and enzyme activity;
- Examination and evaluation of the effects of microorganisms in water and wastewater;
- Study of microscopes, microbial staining and pure culture techniques, nutritional requirements cultivation and growth;
- Enumeration of microorganisms in water, standard plate count; indicator organisms,
- Control of microorganisms by physical and chemical agents; the structure "and biological functions of microorganisms including bacteria, protozoa, algae, viruses;
- Micro biology of water and wastewater; soil; and food.
- Biodegradation and bioaccumulation.

Books Recommended: (Latest Ed. Where Possible)

1. Prescott L M, Harley G P, Klei C A 1992. Microbiology (4th edition). McGraw-Hill Inc.
2. Telear M A, Chan E C S Microbiology: Concepts and Applications. McGraw-Hill Inc.
3. Mitches R, Environmental Microbiology, McGraw-Hill Inc.
4. Denyer S P, Gorman S P Microbial Bioskills: Formation and Control. McGraw-Hill Inc.

SENIOR DESIGN PROJECT – I

SENIOR DESIGN PROJECT - II