CURRICULUM FOR

ADVANCED DIPLOMA IN LAND RESOURCE SURVEY & GIS

6-MONTHS
(Certificate course)

National Vocational & Technical Training Commission, Islamabad (February, 2012)

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TRAINING OBJECTIVES

The objectives of this course are to:

- Boost up agriculture production through adoption of appropriate management technology and systematic development/improvement of the agriculture land resources.
- Provide research facilities to other organizations for conservation of the resources for the coming generations.
- Obtain adequate expertise in GIS/RS and land evaluation for agriculture planning

CURRICULUM SALIENT POINTS

Minimum Entry Level: B.Sc. in Soil Science/ Agriculture/ Agri. Chemistry/ Chemistry/ Botany/ Geology/ Geography/ GIS/ Environmental Sciences OR Diploma in Agriculture Sciences

Duration of course:	6-Months
Training Hours:	800 hours 40 hours per week 7 Hrs. per day (5hrs. on Friday)
Training Methodology:	Practical: 70% Theory: 30%

Lectures through Multimedia/practical/field demonstrations

Medium of Instruction: English

- 1 Hour per week for Work Ethics

SKILL COMPETENCY DETAILS

On successful completion of this course, the trainee should be able to:

1. Identify the soil types in the field and also will be in a position to suggest appropriate land use/management
2. Carry out Soil Surveys using GIS/RS techniques
3. Perform soil, water and plant Analysis
4. Do the Soil Classification according to USDA system and its judicious/optimum use
5. Mapping through GIS
6. Amelioration of saline sodic soils and its management.
7. Categorize different Land Types
8. Classify Soil Problems and their on-farm management

KNOWLEDGE PROFICIENCY DETAILS

On successful completion of this course, the trainee should be able to:

1. Understand basic concept of Soils
2. Built know how about Land Resources of Pakistan
3. Know about different Land Types
4. Describe Soil Problems and their on-farm management
5. Interpret Land Resource Data for agriculture and non-agriculture purposes
6. Deduce soil, water and Plant Lab. Data.
7. Illustrate crop suitability according to land types
8. Suggest different development alternatives

CURRICULUM DELIVERY STRUCTURE

WEEK	Curriculum Delivery	Make up Session	Revision	Co-curricula Activities	Final Test	Total
	1-20	21-22	23-24	25	26	26
	20	2	2	1	1	

SCHEME OF STUDIES

Advance Diploma in Land Resource Survey & GIS

(6-Months Course)

S. No	Main Topics	Theory Hours	Practical Hours	Total Hours
1.	Introduction to Soil Survey of Pakistan & Geomorphology of Pakistan	21	25	36
2.	Soil Genesis, Soil Identification & Soil Classification	116	159	275
3.	Remote Sensing Techniques & Geographical Information System	44	100	144
4.	Land Resource Survey & Mapping through GIS/RS	40	100	140
5.	Land Evaluation	30	30	60
6.	Soil, water & plant analyses	10	30	40
7.	Final Project/Research Assignment	15	80	95
	Total	**240**	**560**	**800**

DETAIL OF COURSE CONTENTS
Advance Diploma in Land Resource Survey & GIS

(6-Months Course)

Sr. No	Detail of Topics	Theory Hours	Practical Hours
1.	**Introduction to Soil Survey & Geomorphology of Pakistan**		
	1.1 History	1	
	1.1.1 The need	1	
	1.1.2 Establishment		
	1.2 Mission and Objectives	1	
	1.2.1 Preparation of Land resource inventory	0.5	
	1.2.2 Updation of land resource inventory	0.5	
	1.2.3 Interpretation of data		
	1.3 Activities		
	1.3.1 Soil Surveys inventories	0.5	
	1.3.2 Land information services		
	1.3.3 Laboratory services		
	1.3.4 Soil reference centre and information services	0.5	
	1.3.5 Consultancy and training services		
	1.3.6 Quality control		
	1.3.7 Development projects	1	
	1.3.8 Future Planning		2
	1.3.9 Visit of Labs/GIS section		4
	1.3.10 Orientation to use of equipments	1	1
	1.3.11 Preparation of plans about course activates		
	1.4 Introduction		
	1.4.1 Geology	1	
	1.4.2Geomorphology		
	1.4.3 Landforms	1	
	1.4.4 Landforms Units	1	
	1.4.5 Identification of rock types		1
	1.4.6 identification of Landforms in the field	1	4
	1.5 Genesis of Landscapes		
	1.5.1 Erosion	0.5	
	1.5.2 Sedimentation	0.5	
	1.5.3 Human Influence	1	
	1.5.4Tracing of drainage patterns and erosion features from the topo sheets		3
	1.6 Landforms of Pakistan		
	1.6.1 Mountains and hills	1	
	1.6.2 Piedmont Plains	2	
	1.6.3 River Plains	2	
	1.6.4 Loess Plains	1	
	1.6.5 Sand Plains	1	
	1.6.6 Estuary Plains	1	
	1.6.7 Identification of landforms in the field		10
2.	**Soil Genesis, Identification & Classification**		
	2.1 Introduction		
	2.1.1 Modern Concept of Soil	1	

	2.1.2 Soil Forming Factors	1	
	2.1.3 Soil Parent Materials		
	2.1.4 Climate	1	
	2.1.5 Hydrology	1	
	2.1.6 Physigraphy		
	2.1.7 Soil Biology	1	
	2.1.8 Human influence	1	6
	2.1.9 Identification of soil forming factors in the field		
	2.2 Genetic Modeling of Soil Systems		
	2.2.1 Energy Model	1	
	2.2.2 Open Systems approach	1	
	2.2.3 Closed systems approach	1	
	2.2.4 Equilibrium and steady state theory	1	
	2.2.5 Soil Landscape Model	1	
	2.2.6 General systems theory	1	2
	2.2.7 Identification riverain landscapes in the field		
	2.3 Soil Forming Processes		
	2.3.1 Homogenization	2	
	2.3.2 Structure Formation	1	
	2.3.3 Littering and Humification	1	
	2.3.4 Elluviation & Illuviation	1	
	2.3.5 Leaching	1	
	2.3 6 Decalcification/Calcification	1	
	2.3.7 Salinization/Alkalization	1	
	2.3.8 Gleying/Motteling	1	
	2.3.9 Weathering and Clay formation	1	
	2.3.10 Pedoturbation	1	6
	2.3.11 Identification of soil processes from soil morphology in the field		
	2.4 Soil Identification		
	Profile Description		
	2.4.1 Introduction	2	
	2.4.2 Master Horizons and Subordinate Distinctions	8	
	2.4.3 Identification of Master Horizons and Layers in the Field		10
	2.4.4 Study of horizons sequences in the field		10
	2.5 Soil Morphology		
	2.5.1 Soil Series Differentiae	2	
	2.5.2 Environmental Characteristics	2	
	2.5.3 Soil Color/Mottles Color	1	
	2.5.4 Soil Texture	2	
	2.5.5 Soil Structure	2	
	2.5.6 Soil Consistence	2	
	2.5.7 Cutans	1	
	2.5.8 Roots	1	
	2.5.9 Porosity	1	
	2.5.10 Calcareousness	1	
	2.5.11 Soil Salinity	1	
	2.5.12 Soil pH	1	
	2.5.13 Presence of Artifacts	1	
	2.5.14 Horizon Boundary	2	
	2.5.15 Identification and designation of Master horizons and layers in the field		6
	2.5.16 Identification of dry/moist/wet soil color by Munsell color chart		4

	2.5.17 Assessment of soil texture by feel method		8
	2.5.18 Identification of soil structure by size, shape and strength		6
	2.5.19 Assessment of soil porosity by kind, size and abundance of pores		5
	2.5.20 Assessment of soil calcareousness by 10% HCl		2
	2.5.21 Determination of Soil reaction by Thymol Blue		2
	2.5.22 Demarcation of horizon boundaries by shape and distinctness		7
	2.5.23 Complete description of a soil profile		10
	2.6 Soil classification		
	Introduction		
	2.6.1 Purpose	5	
	2.6.2 History of Soil Classification	5	
	2.7 Soil classification systems		
	2.7.1 USDA -Soil Taxonomy	15	
	2.7.2 FAO – Soil Groups	5	
	2.7.3 Other Systems	5	
	2.7.4 On-site Classification of Five Soils of Different Landscapes in the Field		25
	2.8 Soil Taxonomy		
	2.8.1 Diagnostic Surface Horizons	6	
	2.8.2 Diagnostic Subsurface Horizons	10	
	2.8.3 Diagnostic Properties	10	
	2.8.4 Soil Taxonomy Categories – Higher	2	
	2.8.5 Soil Taxonomy Categories – Lower	2	
	2.8.6 Identification of Ochric Epipedon in the Field		3
	2.8.7 Identification of Mollic Epipedon in the Field		4
	2.8.8 Identification of Cambic Horizon in the Field		4
	2.8.9 Identification of Argilic Horizon in the Field		5
	2.8.10 Identification of Calcic Horizon in the Field		5
	2.8.11 Identification of Salic Horizon in the Field		5
	2.8.12 Identification of Natric Horizon in the Field		5
	2.8.13 Determination of soil moisture regime		3
	2.8.14 Determination of soil temperature regime		3
	2.8.15 Determination of soil particle size class		3
	2.8.16 Determination of soil mineralogy class		3
	2.8.17 Determination of soil other diagnostic properties		7
	Remote Sensing Technique		
3.	**3.1 Introduction**	2	
	3.1.1 Remote Sensing	1	
	3.1.2 Sensor	1	2
	3.1.3 Platform	2	
	3.1.4 Wavelength regions		5
	3.2 Classification of Electromagnetic Radiations	3	5
	3.2.1 Spectral Reflectance of Land Covers	3	
	3.2.2 Spectral Reflectance of different kinds of Plant		
	3.3 Image Interpretation	1	6
	3.3.1 Introduction	2	6
	3.3.2 Image reading	2	
	3.3.3 Image Analyses	1	

	3.3.4 Thematic Map		8
	3.4 Image Processing	3	6
	3.4.1 Reconstruction/ Correction	1	6
	3.4.2 Transformation	2	
	3.4.3 Classification		
	3.5 Geographical Information System (GIS) Introduction	1	
	3.5.1 What is GIS?	1	
	3.5.2 Why is a GIS needed	1	2
	3.5.3 Required Functions for GIS	1	2
	3.5.4 Basic Functions of GIS	1	1
	3.5.5 Computer System for GIS	1	
	3.5.6 Area of GIS applications		
	3.6 GIS as Information Infrastructure	1	
	3.6.1 Open Data Policy	1	6
	3.6.2 Standardization	2	6
	3.6.3 Data/Information Sharing	2	5
	3.6.4 Networking	1	3
	3.6.5 Multi-disciplinary approach	1	
	3.6.6 Interoperable Procedure		13
	3.7 Data Model and Structure	3	12
	3.7.1 Vector Model	3	
	3.7.2 Raster Model		
	Land Resource Survey and Mapping through GIS/RS		
4.	**4.1 Introduction**	2	
	4.1.1 Objectives	2	
	4.1.2 Kinds of Soil Surveys	1	
	4.1.3 Constitution of Soil map Unit		
	4.2 Base maps	3	
	4.2.1 Topo sheets	4	
	4.2.2 Aerial Photographs	4	
	4.2.3 Satellite images	2	
	4.2.4 Plain Tabling	2	3
	4.2.5 Contouring and Land Leveling		
	4.2.6 Identification of Infrastructure and Landmarks on topo-sheets		3
	4.2.7 Identification of Infrastructure and Landmarks on aerial Photographs		3
	4.2.8 Identification of Infrastructure and Landmarks on image sheets		6
	4.2.9 Preparation of Map of an Agricultural Farm by Plain tabling		5
	4.2.10 Drawing of Contours on a Map		
	4.3 Field Surveys		
	4.3.1 Pre-field studies	3	
	4.3.1.1 Procurement of relevant data	1	
	4.3.1.2 Detail Programming	2	
	4.3.1.3 Interpretation of data	1	
	4.3.1.4 Field Kits		
	4.3.2 Regular Survey	3	
	4.3.2.1 Exploratory Traverses	2	
	4.3.2.2 Legend Design	3	10
	4.3.2.3 Survey Work		20

	4.3.3 Exploratory Survey of any Area		20
	4.3.3.1 Reconnaissance Survey of any Area		10
	4.3.3.2 Semi-detailed Survey of any Area		
	4.3.3.3 Detailed Survey of a Farm		
	4.4 Soil Sampling for Lab. analyses	1	
	4.4.1 Selection of Sampling Sites	3	
	4.4.2 Excavation of Soil Pits	1	20
	4.4.3 Profile Description		
	4.4.4 Collection of Soil and water samples		
	Land Evaluation		
5.	**5.1 Introduction**	01	
	5.1.1 What is Land 5.1.2 What is Land Evaluation		
	5.1.3 Kinds of Land Evaluation	2	
	5.1.1.4 Systems of Land Evaluation	2	
	5.2 Land Capability		
	5.2.1 Outline of the System	3	
	5.2.2 Class and Sub-Class category	1	3
	5.2.3 Land Capability mapping unit	1	
	5.2.4 Determination of Land Capability Class of an irrigated land		3
	5.2.5 Determination of Land Capability Class of an Rain-fed Land		2
	5.2.6 Determination of Land Capability Class of an torrent-watered Land		2
	5.2.7 Determination of Land Capability Class of an flooded Land		
	5.3 Land Suitability	1	
	5.3.1 Introduction to Land Suitability	1	
	5.3.2 General Concept		
	5.3.3 Classification Categories		
	5.3.3.1 Land Suitability order	1	
	5.3.3.2 Land Suitability Class		
	5.3.3.3 Land Suitability Unit	2	
	5.3.4 Land Utilization Types	2	
	5.3.5 Land Qualities	1	
	5.3.6 Rating Method of Land Quality		
	5.3.7 Crop Requirement	1	
	5.3.8 Degree of Limitation	1	
	5.3.9 Land suitability Mapping		3
	5.3.10 Identification of Land utilization types in the field		3
	5.3.11 Identification of Land qualities in the field		
	5.3.12 Determination of Land suitability of an irrigated area		7
	5.3.13 Determination of Land suitability of a dry-farmed area		7
	5.4 Soil Problems/Management		
	5.4.1 Soil Degradation/Desetificaion	3	
	5.4.2 Soil Salinity & Sodicity	2	
	5.4.3 Conservations and Reclamation	2	
	5.4.4 Soil Drainage	1	
	5.4.5 Moisture Shortage	1	
	5.4.6 Flooding	1	
	5.4.7 Socio-Economics		

	Soil, Water and Plant Analyses	2	
6.	6.1 Introductions	8	
	6.2 Analytical Procedures		
	6.3 Determination of Particle Size by Day's Method		
	6.4 Determination of Organic matters		8
	6.5 Determination of $CaCO_3$ percent		4
	6.6 Determination of CEC		3
	6.7 Determination of pH, EC and Sol. Ions .		8
	6.8 Calculation of gypsum requirement of Saline-sodic Soils		4 3
	Final Project	5	
7.	7.1 Project planning	5	
	7.2 Acquisition of data and cartographic	5	10
	7.3 Acquisition of field equipment and logistic		30
	7.4 Pre-field Activities		30
	7.5 Field Survey		10
	7.6 Report Preparation		
	7.7 Presentation		
Total:		**240**	**560**

LIST OF TOOLS / EQUIPMENT / LAB / WORKSHOP

(For A Class Of 25 Students)

Name of Course	Advance Diploma in Land Resource Survey & GIS
Duration of Course	6 – Months

Sr. No	Name of Tools/ Equipments	Quantity
1	Computers	25
2	Printers	25
3	Plotters	8
4	U.P.S.	20
5	Software's ARC GIS, ARCINFO/ARC VIEW, ERDAS, MAPINFO and Oracle	10
6	Field kits	30
7	Internet facilities	available
8	Digitizing tables	4
9	Scanner	4
10	G.P.S. Handy	25
11	Atomic Absorption Spectrophotometer	1
12	pH-meter	3
13	Conductivity Meter	3
14	Flame Photo meters	3
15	Mechanical Stirrer	3
16	Air-conditioner Split Type	4

- Computers Labs.
- Soil, Water and Plant analyses Labs.
- Monolith Lab.
- Air-conditioned lecture rooms
- Logistics

LIST OF CONSUMABLE MATERIAL

(For A Class Of 25 Students)

Name of Course	Advance Diploma in Land Resource Survey & GIS
Duration of Course	6 – Months

Sr. No	Name of Consumable items	Quantity
1	Chemicals for Soil, plant and water analyses	All chemicals are available
2	For Field chemicals/indicators	All chemicals/indicators are available
3	A4 size papers	According to requirement
4	Cartridge	As required

MINIMUM QUALIFICATION OFTEACHER / INSTRUCTOR

Qualification, experience, age and salary

1. Principal (BS-20)	2nd class Master's degree in Soil Science/Agronomy/ Chemistry/Agri. Chemistry 45-65 years 20 years field experience in modern soil survey/ mapping, land evaluation/ land capability classification, report writing and interpretation of soil survey data for agricultural land use, with at least 15 years service in BPS-17 & above; experience in soil survey work and in GIS with a reputed international organization in the fields preferred. Foreign qualified will be preferred
2. Sr. Instructor (BS-19)	2nd class Master's degree in GIS, Soils Science/ Agri. Chemistry, Soil Chemistry or Agronomy 45-65 years 15 years field experience in modern soil survey/mapping using remote sensing data/air-photos, land capability classification and report writing. Additional experience/expertise in working with satellite remote sensing data (SPOT/Land sat images) for soil and land use mapping is preferred.
3. Sr. Instructor (BS-19)	2nd class Master's degree in Space Science, GIS, Geometrics 45-65 years Information Technology/ Information Systems, Chemistry or Geography with a training course in GIS/Image Processing from a reputed institution**.** 10 years experience in management of computer systems/networks and use of software related to GIS and image processing for preparation of soil and land resource maps. Five years experience in remote sensing data is additionally require Foreign qualified will be preferred.
4 . Instructor (BS-18)	2nd class Master's degree in Soils Science/Agri. Chemistry, Soil Survey, Soil Chemistry or Agronomy. 45-65 years 8 years field experience in modern soil survey/mapping, using remote sensing data/air-photos, soil correlation and Classification with FAO-UNESCO's World Soil Map Legend and USDA Soil Taxonomy. Additional experience/expertise in working with satellite remote sensing data (SPOT/Land sat images) for soil and land use mapping is preferred.
5. Instructor (BS- 18)	2nd class Master's degree in Space Sciences, GIS, Information Technology/ Geometrics Information Systems, Chemistry or Geography with a training course in GIS/ Image Processing from a reputed Institution. 45-65 years

	8 years experience in management of computer systems/networks and use of software related to GIS and image processing for preparation of soils and land resource maps. Three years experience in remote sensing data is additionally required.
6. Demonstrator (BS-17)	2nd class Master's degree in Computer Science Space Sciences, GIS Geometrics Information Technology/ Information Systems;Geography. 25-35 years

EMPLOYABILITY OF PASS-OUTS

The pass-outs of this course may find job/employment opportunities in the following sectors / areas.

- Agriculture departments
- Foreign, national contractors/firms and NGO'S
- Agro-chemical industries

REFERENCE BOOKS

- Soil Survey Manual, National Soil Survey Hand Book
- Munsel Soil Color Chart
- Nature & Properties of Soils
- Hand Book-60
- Soil Survey Reports and maps (Soil & Landforms, Land capability, land Use and land suitability),
- Soil keys
- Official Soil series of Pakistan and lecture notes.
- Digital image processing in remote sensing by J.P. Muller
- Aerial photography and remote sensing for Soil Survey (monographs on soil survey) by White,.
- Applied remote sensing by CPLO
- A to Z GIS by Shelle Shomme,
- GIS for every one (David E Davis)
- GIS data conversion, strategies, techniques-management by Pat Hohl (ed)
- GIS and Organization (How effective are GIS in practice)
- Geographical data analyses by Nigel Walford.

NAMES OF NATIONAL CURRICULUM & REVIEW COMMITTEE MEMBERS

- Mr. Muhammad Ikram, Principal, National Institute of Research in Soils & Geomatics, Soil Survey of Punjab, Lahore
- Mr. Muhammad Yousaf, Senior Instructor, National Institute of Research in Soils & Geomatics, Soil Survey of Punjab, Lahore
- Mr. Zia ul Hassan Shad, Project Director, Pak-German Polytechnic Institute for Agriculture Technology, Chak 5 Faiz, Multan
- Mr. Saleem Haider, Agriculture Officer, Pak-German Polytechnic Institute for Agriculture Technology, Chak 5 Faiz, Multan
- Mr. Nadeem Zaigham, Senior Instructor, Government College of Technology, Raiwind Road, Lahore
- Mr. Rahat Ali Asi, Associate Engineer (Survey), NESPAK, Lahore
- Engr. Abdul Rashid, Associate Professor (Civil), Govt. College of Technology, Kohat (KPK)
- Mr. Imran Zafar, Senior R.S. Analyst, NESPAK, Lahore
- Mr. Muhammad Islam, Principal, Government College of Technology, Multan
- Sheikh Abdul Karim, Assistant Professor, Government College of Technology, Karachi