

**CURRICULUM**  
**OF**  
**AGRICULTURAL ENGINEERING**

**BS/BE/BSc**

(Revised 2010)



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD**

## **CURRICULUM DIVISION, HEC**

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## PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum one can judge the state of intellectual development and the state of progress of the nation. The world has turned into a global village; new ideas and information are pouring in like a stream. It is, therefore, imperative to update our curricula regularly by introducing the recent developments in the relevant fields of knowledge.

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 4<sup>th</sup> 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 Agriculture met in 2009 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 Bachelor (BS) degree shall be of 4 years duration, and will require the completion of 130-140 credit hours. For Agriculture degree programme 77% of the curriculum will consist of discipline specific and supporting Agriculture courses, and 23% will consist of compulsory and general 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, respective accreditation councils and stake holders. The National Curriculum Revision Committee for Agriculture Extension in a meeting held on May 24-26, 2010 at HEC Regional Centre, Karachi in continuation of preliminary meeting held on December 2009 at HEC Regional Center, Karachi, revised the curriculum in light of the unified

template. The revised curriculum is being circulated for implementation in the concerned institutions.

**PROF. DR. ALTAF ALI G. SHAIKH**  
Member Academics

**March 2010**

## **CURRICULUM DEVELOPMENT**

## INTRODUCTION:

A final meeting of National Curriculum Revision Committee in Agriculture Engineering was held on May, 3-5, 2010 at HEC Regional Centre Lahore to finalize the draft curriculum of agricultural engineering developed in the preliminary held on December 7-9, 2009 at HEC Regional Lahore. The following were present:

Prof. Dr. Zahid Mehmood, Chairman, Department of Agriculture Engineering, NWFP University of Engineering & Technology, Peshawar.	Convener
Prof. Dr. Abdul Rehman Tahir Department of Farm Machinery, University of Agriculture, Faisalabad	Member
Prof. Dr. Maqsood Ahmad, Department of Environmental Management & Policy, Baluchistan University of Information Technology, Engineering & Management Sciences, (BUIEMS), Quetta.	Member
Dr. Muhammad Saffar Mirjat, Professor, Department of Irrigation & Drainage, Sindh Agriculture University, Tandojam.	Member
Prof. Dr. Faizan ul Haq Khan Chairman, Department of Structures & Environmental Engineering University of Agriculture, Faisalabad.	Member
Dr. Nasir Mahmood Khan, Additional Registrar, Pakistan Engineering Council, Attaturk Avenue (East), G-5 / 2, Islamabad.	Member

Mr. Muhammad Naveed Aslam, Lecture, University College of Agriculture & Environmental Sciences, The Islamia University, Bahawalpur.	Member
Engr. Iqbal Zeb Khattak, Faculty of Agriculture, Gomal University, Dera Ismail Khan.	Member
Dr. Muhammad Naeem Chaudhry, Assistant Professor, University College of Agriculture & Environmental Sciences, The Islamia University, Bahawalpur.	Member
Prof. Dr. Jehangir Khan Sial Head / Professor Department of Agriculture Engineering Bahauddin Zakariya University, Multan.	Secretary / Member

#### **Proceedings of Preliminary Meeting:**

The meeting started with the recitation from Holy Quran by Mr. Bashir Ahmad, Director HEC Regional Center, Lahore. Mr. Shafiullah, Dy. Director (Curriculum) HEC Islamabad briefed the members about the unified template of 4 year engineering programme, developed by the conveners of NCRC of engineering disciplines on April 21, 2007 at HEC Islamabad. He requested the members to revise the curriculum of B. Sc. 4 years Agricultural Engineering in line with the unified template of engineering disciplines and also recommend those books which are latest and easily available in the market. The committee then selected Prof. Abdur Rehman Tahir, as a convener and Dr. Zahid Mahmood as Secretary of the meeting. After a long discussion the members agreed on the following format for 4 year agriculture engineering program.

#### **Objective:**

The undergraduate program in Agricultural Engineering was started in early sixties with an overall objective to train manpower for mechanized



and irrigated agriculture of Pakistan. This discipline mainly involves mechanical, civil and environmental engineering principles to solve the problems of crop production and post-harvest processing. The specific objectives are to equip the students with

- a. Sound engineering knowledge
- b. Effective communication skills
- c. High moral values and good engineering ethics
- d. Good analytical skill and systematic program solving capabilities
- e. Inquisitive mind to undertake research for solving engineering problems.
- f. Scientific skills to manage the human and technological resources optimally
- g. Effective leadership and decision making skill.

### **Proceedings of Final NCRC Meeting:**

The meeting started with the recitation of Holy Quran. Before normal proceeding of the meeting, Fateha was offered for the departed soul of Prof. Dr. Abdul Rehman Tahir who acted as convener in the preliminary meeting. Prof. Dr. Altaf Ali G. Sheikh Member (Academics) HEC Islamabad welcome the participants of the meeting on behalf of the Chairman HEC Islamabad. He asked them consider the comments of the expatriate Pakistani experts and expert opinion / views of the expert of the faculty and NCRC Member while finalizing the preliminary draft of Agricultural Engineering. He also told that the final draft of Engineering Agricultural will be circulated among all the relevant universities / faculty members for further improvement before final printing. He wished that maximum efforts should be made to have standard curriculum of Agricultural Engineering. After this Prof. Dr. Zahid Mehmood, was requested to act as new convener of the committee and Prof. Dr. Jehangir Khan Sial as Secretary of the final meeting. The committee then studied in detail the comments of expatriate Pakistani Expert and rectified all the courses one by one. The committee decided that the final draft will be circulated to all NCRC member and they will examine all the relevant courses assigned to them during the meeting for further improvement and development. The worthy members will send those developed courses to the convener and secretary within one week along with comments if any.

## B.Sc AGRICULTURAL ENGINEERING

Duration:	4 years
Number of semesters:	8
Number of weeks per semester:	16 - 18 (minimum 16 for teaching and 2 weeks for examinations)
Total number of credit hours:	136
Number of credit hours per semester:	15 - 18
Engineering Courses (Minimum):	69.88 per cent
Non-Engineering Courses (Maximum):	30.12 per cent

Non-Engineering Domain										
Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	Credit Hours	Total Courses	Total Credits	% Area	% Overall	
Humanities	English	English Composition &	3	0	3	2	6	14.6	4.41	
		Communication & Presentation	3	0	3					
	Culture	Islamic Studies	2	0	2	2	4	9.8	2.94	
		Pakistan Studies	2	0	2					
	Social Sciences	Professional Ethics	Sociology	2	0	2	2	4	9.8	2.94
			Sociology	2	0	2				
Management Sciences	--	Engineering Economics & Management	3	0	3	1	3	7.3	2.20	

Natural Sciences	Math	Linear Algebra & Calculus	3	0	3	4	12	29.3	8.82
		Differential Equations & Power	3	0	3				
		Numerical Analysis	2	14	3				
		Statistics & Probability	2	1	3				
	Physics	Applied Physics	2	1	3	1	3	7.3	2.20
	Chemistry	Industrial Chemistry	2	1	3	1	3	7.3	2.20
	Electives	Basic Agriculture	2	1	3	2	6	14.6	4.41
		Soil Science	2	1	3				
						15	41	10	30.12

\* Math/Physics/Chemistry/Biology/Engineering Economics or related subject as appropriate for the program  
Lec CH: Lecture Credit Hours, Lab CH: Laboratory Credit Hours

## BS ENGINEERING PROGRAM

Engineering Domain																																																																												
Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	Credit	Total Cour	Total Credits	% Area	% Overall																																																																			
Computing	Programming	Computer Programming	1	1	2	2	5	5.26	3.67																																																																			
	Design	Computer Application in Engineering	2	1	3					Engineering Foundation	--	Fluid Mechanics	2	1	3	9	28	29.47	20.58	Engineering Drawing & Graphics	1	2	3	Metallurgy and Workshop Practices	2	1	3	Soil Mechanics	2	1	3	Manufacturing Engineering	2	1	3	Engineering Mechanics	2	1	3	Engineering Thermodynamics	2	1	3	Engineering Hydrology	2	1	3	Surveying and Leveling	2	2	4	Major Based Core (Breadth)	-- -	Open Channel Hydraulics	2	1	3	11	33	34.73	24.26	Farm Power	2	1	3	Mechanics of Materials	2	1	3	Irrigation Engineering	2	1	3	Machine Design	2	1
Engineering Foundation	--	Fluid Mechanics	2	1	3	9	28	29.47	20.58																																																																			
		Engineering Drawing & Graphics	1	2	3																																																																							
		Metallurgy and Workshop Practices	2	1	3																																																																							
		Soil Mechanics	2	1	3																																																																							
		Manufacturing Engineering	2	1	3																																																																							
		Engineering Mechanics	2	1	3																																																																							
		Engineering Thermodynamics	2	1	3																																																																							
		Engineering Hydrology	2	1	3																																																																							
Surveying and Leveling	2	2	4																																																																									
Major Based Core (Breadth)	-- -	Open Channel Hydraulics	2	1	3	11	33	34.73	24.26																																																																			
		Farm Power	2	1	3																																																																							
		Mechanics of Materials	2	1	3																																																																							
		Irrigation Engineering	2	1	3																																																																							
		Machine Design	2	1	3																																																																							
		Instrumentation	2	1	3																																																																							

		Drainage Engineering	2	1	3				
		GIS and Remote Sensing	2	1	3				
		Soil and Water Conservation Engineering	2	1	3				
		Farm Machinery and Earth Moving Equipment	2	1	3				
		Agricultural Processing Engineering	2	1	3				
<b>Major Based Core (Depth)</b>		Engineering Elective-I	2	1	3	6	18	18.94	13.23
		Engineering Elective-II	2	1	3				
		Engineering Elective-III	2	1	3				
		Engineering Elective-iv	2	1	3				
		Engineering Elective-v	2	1	3				
		Engineering Elective-vi	2	1	3				
Inter-Disciplinary	--	Environmental Engineering	2	1	3	2	5	5.26	3.67
		Farm Structure and Materials	2	0	2				
Senior Design	--	Senior Design Project-I	0	3	3	2	6	6.31	4.41
		Senior Design Project-II	0	3	3				
Industrial Training (Summer)			0	0	0	0	0	0	0
<b>Total: 95</b>			<b>58</b>	<b>37</b>	<b>95</b>	<b>31</b>	<b>95</b>	<b>100</b>	<b>69.88</b>

SCHEME OF STUDIES FOR UNDERGRADUATE COURSES FOR ACADEMIC SESSION 2009-2010 AND ONWARDS									
Semester 1					Semester 2				
No.	Course	C.H			No.	Course	C.H		
		Lecture	Lab	Total			Lecture	Lab	Total
1	Islamic Studies	2	0	2	1	Pakistan Studies	2	0	2
2	Linear Algebra & Calculus	3	0	3	2	Engineering Mechanics	2	1	3
3	Applied Physics	2	1	3	3	Manufacturing Engineering	2	1	3
4	Fluid Mechanics	2	1	3	4	Soil Science	2	1	3
5	Engineering Drawing & Graphics	1	1	2	5	Basic Agriculture	2	1	3
6	Metallurgy and Workshop Practices	2	1	3	6	Computer Aided Design	1	1	2
7	English Composition & Comprehension	2	0	2					
	<b>Total Credit Hours</b>	<b>14</b>	<b>4</b>	<b>18</b>		<b>Total Credit Hours</b>	<b>11</b>	<b>5</b>	<b>16</b>

Semester 3				
		C.H		
No.	Course	Lecture	Lab	Total
1	Differential Equations, Power Series, Laplace Transform	3	0	3
2	Sociology	2	0	2
3	Engineering Hydrology	2	1	3
4	Surveying & Leveling *	2	2	4
5	Computer Programming and Applications in Engineering	1	2	3
6	Engineering Thermodynamics	2	1	3
<b>Total Credit Hours</b>		<b>12</b>	<b>6</b>	<b>18</b>
Semester 5				
		C.H		
No.	Course	Lecture	Lab	Total
1	Communication & Presentation Skills	2	1	3
2	Statistics & Probability	2	1	3

Semester 4		C.H		
No.	Course	Lecture	Lab	Total
1	Soil Mechanics	2	1	3
2	Open Channel Hydraulics	2	1	3
3	Farm Power	2	1	3
4	Mechanics of Materials	2	1	3
5	Landscape Engineering	2	1	3
6	Farm Structures & Materials	2	1	3
<b>Total Credit Hours</b>		<b>12</b>	<b>6</b>	<b>18</b>
Semester 6				
		C.H		
No.	Course	Lecture	Lab	Total
1	Professional Ethics	2	0	2
2	Drainage Engineering	2	1	3
3	Soil & Water Conservation Engineering	2	1	3

3	Irrigation Engineering	2	1	3	4	GIS & Remote Sensing	2	1	3
4	Elective – I	3	0	3	5	Farm Machinery & Earth Moving Equipment	3	1	4
5	Environmental Engineering	2	1	3	6	Elective – II	3	0	3
6	Instrumentation & Measurements	2	1	3					
	<b>Total Credit Hours</b>	<b>13</b>	<b>5</b>	<b>18</b>		<b>Total Credit Hours</b>	<b>14</b>	<b>4</b>	<b>18</b>
<b>Semester 7</b>					<b>Semester 8</b>				
		<b>C.H</b>					<b>C.H</b>		
<b>No.</b>	<b>Course</b>	<b>Lecture</b>	<b>Lab</b>	<b>Total</b>		<b>Course</b>	<b>No.</b>	<b>Lab</b>	<b>Total</b>
1	Machine Design	3	0	3	1	Elective-IV	3	0	3
2	Industrial Chemistry	2	1	3	2	Engineering Economics & Management	3	0	3
3	Agricultural Processing Engineering	2	1	3	3	Numerical Analysis	2	1	3
4	Elective-III	3	0	3	4	Pumps and Tube wells	2	1	3
5	Project & Report	0	2	2	5	Project & Report	0	4	4
					6				
						<b>Total Credit Hours</b>	<b>10</b>	<b>6</b>	<b>16</b>
	<b>Total Credit Hours</b>	<b>10</b>	<b>4</b>	<b>14</b>					



Total Credit Hours for B.Sc  
Agricultural Engineering = **136**

**Note:**

1. *A mandatory two to three weeks survey camp to be arranged during summer semester after 4<sup>th</sup> semester*
2. *A supervised internship training to be arranged by the institution after 6<sup>th</sup> semester as the requirement of the degree.*
3. *Project & Report will be completed in two Semesters (i.e. 7th & 8th Semesters)*

## BS ENGINEERING PROGRAM

### Summary

Domain	Knowledge Area	Total	Total	% Overall
Non-Engineering	Humanities	14	14	30.12
	Management Sciences	3	3	
	Natural Sciences	24	24	
	Sub Total	41	41	
Engineering	Computing	5	5	69.88
	Engineering Foundation	28	28	
	Major Based Core (Breadth)	33	33	
	Major Based Core (Depth)	18	18	
	Inter-Disciplinary Engineering Breadth (Electives)	5	5	
	Senior Design Project	6	6	
	Industrial Training (Summer)	0	0	
	Sub Total	95	95	
Total		136	136	100

*The curriculum design is based on the concept of foundation, breadth and depth courses so that streams for different specializations can be created within each discipline.*

**Foundation Courses:** *The foundation courses are the courses that all students in a given discipline of engineering must take. These courses provide students with the fundamental concepts and tools to pursue their studies at the higher level.*

**Breadth Courses:** *The breadth courses introduce students to different specialties in the given discipline of engineering early in their studies. Before taking the breadth courses, the students should be advised that their choices will affect taking follow up courses because of pre-requisite requirement.*

**Depth Courses:** *The depth courses offer specialization within each engineering discipline. All depth courses must integrate a substantial design component.*

*The students may select electives from any of the areas of specialization with some guidelines from their respective advisors.*

## SEMESTER - 1

### Linear Algebra and Calculus

3(3-0)

#### Objective:

- To learn fundamentals of algebra & calculus.

#### Vector Algebra:

Introduction to scalars and vectors, vectors in a plane, scalar and vector products, Line in  $R^2$ ,  $R^3$  and planes, Spheres, Orthogonal Projections, Perpendicular distance from a point to a line and a plane, vector spaces, Subspaces, Linear combinations, linearly dependent and interdependent set of vectors, Spanning of a vector spaces, Bases of a vector spaces and its application in engineering and a business.

#### Matrix Algebra:

Introduction to matrices, Matrix operations, matrix operations, Inverse Matrix, Rank of a matrix, Echelon form of a Matrix and its applications in our daily life situation problems, i.e., in line-communication as Air lines, Telephone-lines, Connecting cities by roads.

#### Determinants:

Determinants and its properties, Inverse of a Matrix, Rank of a Matrix, Linearly dependent and independent by determinants.

#### Linear System Of Equations:

Independent, Dependent and inconsistent system of equations and its graphical representation, trivial and non-trivial solution of homogeneous system of linear equations and its application as linear models in business, economics, Science, Electric Circuits and other branches of engineering. Solution of linear system of equations by determinants and its application as Leontief input-output matrix of the economy, coding and decoding theory.

#### Linear Transformation:

Reflection operators, Projection operators, Rotation operators, Shear in X and Y directions, Dilation and contraction.

## **Eigen Values and Eigen Vectors:**

Eigen values and Eigen vectors and its applications as deformations, Markov processes as Mass Transit Problems, Forecasting of weather and to develop the solution of the system of differential equations for Mechanical systems/Electrical systems and Agricultural/Civil Engineering especially in Public Health Engineering Problems.

## **Single Variable Calculus:**

Basic concepts of single variable function, continuous, discontinuous and piecewise continuous functions, periodic, odd and even functions, algebraic functions, transcendental functions and its graphical representations, applications of functions in our daily life situations.

## **Differential Calculus:**

Limits and continuity, interpretation of a derivative, geometric interpretation, total differential and its applications in our daily life situations, the use of a table of different type derivatives, higher order derivatives, tangents and normal, approximations of a function at a particular point by Tylor's and Maclaurin's series, maximum and minimum values of a function, the first derivative test, the second derivative test, point of inflexion and its applications in business and engineering.

## **Integral Calculus:**

Basic concepts of integration, a table of integral formulas, some rules of integration, definite integrals, the area bounded by a curve, integration by parts, integration as the limit of a sum, volume revolution, and its application in daily life situations.

## **Multivariate Calculus:**

Basic concepts of multivariate function, level curves and surfaces, limit and continuity, partial differentiation, vector functions and its differentiation and integration, the directional derivative, the gradient, scalar and vector fields, normal properties of the gradient, divergence, curl, tangents planes and normal lines, extreme of functions of two variables, second partial test, extreme value theorem, methods of constrained optimization and LaGrange multipliers.

## **Recommended Books:**

1. Mathematics for Engineers Second Edition by Robert Davison, Addison Wesley

2. Multivariate Calculus, Second Edition by Robert T. Smith, Roland B. Minton, McGraw-Hill Higher Education editions.
3. Linear Algebra and its Applications 2<sup>nd</sup> edition by David C. Lay, Addison-Wesley Publication, Jan. 1998.

## **LANDSCAPE ENGINEERING**

**3(2-1)**

### **Theory:**

Introduction, importance of landscaping, gardening and its design, principles and elements of landscape design, landscape design materials, types of designs; formal and informal garden designs, Chinese and Japanese gardening, rockeries, terrace, roof and water gardens, plants suitable for various designs, landscape designs for public and private buildings, parks and playgrounds etc., highway and roadside plantations, developmental cost estimates for landscape.

### **Practical:**

Visits to different parks and gardens, landscape designs for private and community houses, schools, colleges, universities, municipal and national parks, industrial areas and roadsides; establishing various types of gardens.

### **Books Recommended:**

1. Arora, J.S. 1992. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
2. Booth, N.K. and W.H. Elsevier. 1983. Basic elements in Landscape Architecture Design. Science Publishing Co., New York.
3. Khan, M.A. and T.A. Bader. 1992. Landscape Designs, Student Manual. University Printing Press, University of Agriculture, Faisalabad.
4. McDaniel, G.L. 1982. Ornamental Horticulture. The Reston Publishing Company; Prentice Hall Co., Reston, Virginia.
5. Raj, D. 2002. Floriculture and Landscaping. Kalyani Publisher, New Delhi.

## **Fluid Mechanics**

**3(2-1)**

### **Objective:**

- To study the fundamentals of fluid mechanics including statics and kinematic, concept of energy, momentum, forces and flow

measurement

## **Fundamentals of Fluid Mechanics:**

Definition and branches of fluid mechanics, distinction between solid and fluids,

Properties of fluids: density, viscosity, surface tension, specific weight, specific gravity, etc., bulk modules of elasticity, compressibility of fluids.

## **Fluid Statics:**

Pressure variations in a fluid, pressure measuring devices, gauges and manometers, buoyancy and stability of submerged and floating bodies, forces on plane and curved surfaces, center of pressure.

## **Fluid Kinematics:**

Types of flow, dimensions of flow, streamlines, path lines, flow patterns for different references, continuity equation, source flow, sink flow, flow nets, uses and limitations of flow net.

## **Energy Consideration in Steady Flow:**

General equations of steady flow, heads, Bernoulli's equation and its practical applications, hydraulic and energy grade lines, power consideration in fluid flow, cavitations, head losses, solution of flow problems.

## **Momentum and Forces in Fluid Flow:**

Impulse-momentum principle and application, force exerted on a stationary and moving bodies (flat and curved), relation between absolute and relative velocities, reaction of a jet, jet propulsion, torque in rotating machines.

## **Fluid Flow Measurements:**

Orifices, weirs, notches and venture meter, pitot tube, coefficient of contraction, velocity and discharge, derivation of their discharge formulae and their applications.

## **Practical:**

- ❖ Demonstration of various parts of hydraulic bench

- ❖ Experimental study of laminar and turbulent flow
- ❖ Experimental study of tube gauges and dead weight pressure gauges
- ❖ Calibration of orifices by various methods
- ❖ Calibration of Venturimeter
- ❖ Calibration of rectangular and triangular notch
- ❖ Verification of Bernoulli's theorem
- ❖ Determination of metacentric height
- ❖ Viscosity of a given fluid by viscometer
- ❖ Drag on a small sphere.

### **Books Recommended:**

1. Franzini, J.B. and Finnemore, E.J. 2003. Fluid Mechanics with Engineering Application. McGraw Hill Book Co., Singapore.
2. Jain, A.K. 1990. Fluid Mechanics: A Text Book for Engineering Students. Khana Publishers, New Delhi, India.
3. Streeter, V.L. 1988. Fluid Mechanics. McGraw Hill Inc., New York.
4. Daughterty, R.I., J.B., Franzini, and E.J. Finnemore. 1995. Fluid Mechanics with Engineering Application, McGraw Hill Book Co. Singapore.

## **Engineering Drawing & Graphics**

**2(1-1)**

### **Objective:**

- To enable the students to prepare agricultural and structural drawings manually as well as using computer.

### **Introduction:**

Introduction to engineering drawing, various types of lines, basic geometrical constructions, conic sections, theory of orthographic projection, dimensioning & lettering, Introduction to tolerance, projections off points, projections of straight lines, Projections of planes and solids in simple position, sectioning of solids, Isometric projections, development of surfaces.

### **Practical:**

Introduction to drawing instruments and their use, various scales, practice of orthographic projection missing lines in orthographic projection, Drawing three views of different objects, Practice of



Dimensioning and Lettering, Practice of Sectioning, Conversion of orthographic projection into isometric view, Creating drawings of Engineering Fasteners like Rivets, Cotters Joints, threads etc.

### **Books Recommended:**

1. French, T.E. and Vierch, C.J. 2000. A Manual of Engineering Drawing, McGraw Hill Book Co. New York.
2. Parkinson A.C. 1998. A First year Engineering Drawing, Sir Isaac Pitman and Sons Ltd., England.
3. James, H. Earle. 1992. Engineering Design Graphics , Addison-Wisley Publishing Co. Reading Massachusetts.

### **Metallurgy and Workshop Practices**

**3(2-1)**

Production and properties of common engineering materials: Ferrous metals, iron ores, properties and uses of pig iron, cast iron, wrought iron, steel, standard processes of manufacturing of Iron and steel, open hearth process, basic oxygen processes, production of ingots. Composition/properties and uses of plastics, rubber, fibre glass and composite materials.

Alloy steel and Irons: Effect of alloying elements, the AISI/SAE alloy steel and their identification, corrosion resistant steel, steel for high temperature services, alloy steel.

Non-ferrous metals: Properties and uses of copper, aluminium, zinc, tin, nickel, and lead. Non-ferrous alloys, copper alloys. Aluminium alloys, zinc base alloys, nickel base alloys. Lead-tin alloys, iron-carbon equilibrium diagram Heat treatment: Heat treatment theory and process, heat treatment of steel, annealing, hardening, tempering, normalizing, surface hardening, quenching, heat treatment equipment.

Welding: Definition, types of welding process, survey of welding equipment. Arc welding; Current rating, welding materials, arc welding processes, inspection and testing of welded joints. Gas welding; Welding flames and materials, cutting of metals, gas welding processes.

Foundry: Definition, importance, advantages and disadvantages of foundry, casting, hand moulding tools, characteristics of moulding sand, foundry cores, properties of core and, crucibles, handling and care, copula furnace, construction, zone of copula and its advantages.

Safety and First Aid: Safety in the shop, mechanical and other accidents, safety devices, safety methods, first aid equipment and methods, care and order in the workshop.

### **Practical:**

- ❖ Identification of tools and machines in the workshop.
- ❖ Identification of different metals by spark tests and advance methods.
- ❖ Demonstration of different heat treatment processes.
- ❖ Practice of arc welding.
- ❖ Practice of gas welding.
- ❖ Safety and first aid in the workshop related to electrical, mechanical and other accidents. Safety in the use of hand tools.
- ❖ Visits to local foundries.

### **Books Recommended:**

1. Chapman, W.A.J. 2004. Workshop Technology Part-I.and II. Viva Books Private Ltd., India.
2. Rao.P.N. 2002. Manufacturing Technology: metal cutting and machine tools.Tata McGraw Hill Co. Ltd. New Delhi, India
3. Ostwald, P. H. and J. Munoz. 2002. Manufacturing Processes and systems. 9th edition John wiley and Sons, New York. USA.
4. Havey, D. Miner. 1999. Exploring Pattern Making and Foundry. The MacMillan Co. N.Y., USA.

## **SEMESTER – 2**

### **Basic Agriculture**

**3(2-1)**

#### **Objective:**

- To familiarize students with the basic concepts of crop husbandry.

#### **Introduction:**

Introduction to the Engineering Profession and its Fields of Specialization with particular emphasis on Agricultural Engineering.

#### **Crop Production:**

Major crops of Pakistan, Factors affecting crop production and distribution. Requirements for agricultural development. Classification of field crops based on agronomic use, special purpose and other basis.

### **Seed Technology:**

Role of seed in crop production. Concept of seed technology. Seed Structure and growth, Dormancy, Seed Production and its quality, Seed Processing and Seed Storage.

### **Farming Systems And Tillage Practices:**

Crop rotation. Definition and computation of cropping intensity. Farming systems and its kinds. Objectives of tillage. Effect of tillage on soil conditions, plant diseases and insects.

### **Dry Land Farming:**

Introduction, Importance, Rainfall pattern, Barani cultivation practices, Barani Agro-ecological zones, Problems and constraints of dry land, Dry land improvement, Dry land management, Barani cropping system

### **Land Resources And Management:**

Soil zones and Soil resources of Pakistan. Sustainability of land resources. Managing soil resources.

### **Agro-Meteorology:**

Introduction, Weather and climate, Climatic components, Classification of climates, Climatic factors and crop production.

### **Agro-Ecology:**

Introduction, Agro-ecological Features of Pakistan, Agro-ecological zones, Agro-ecology of NWFP.

### **Recommended Books:**

1. Nazir, S. (1994). Crop Production. National Book Foundation, Islamabad.
2. Martin, J. H., W. H. Leonard and D. L. Stamp. (1990). Principles of Field Crop Production, 3rd edition. Macmillan Co. Inc New York.

## English Composition and Comprehension

3(2-1)

### Objective:

- To enhance students' language skills and develop their critical thinkings.

### Composition (8 Weeks):

- Vocabulary Building skills
- Words & expressions commonly misused.
- Articles; their use, Prepositions; Prepositional phrases.
- Punctuations
- Common Grammatical mistakes
- Elementary Principles of Composition
- Relative Pronouns & Clauses
- Conditional Sentences & types
- Adverbs & Adjectives; their forms & use

### Comprehension (8 Weeks):

- **Getting the essential information:**

Finding the main idea; Defining vocabulary in context; Practice

- **Order of importance:**

Using order in the writing to determine what is most important to the author Similarities & Differences; using comparisons to determine the author's attitude; Sentence structure, degree of detail, description & tone. Practice

- **Critical reading & thinking:**

Evaluating evidence and author credibility, rejecting faulty reasoning Reading across the curriculum; asking the right questions to get the most out of reading in the natural sciences, social sciences & Humanities

- **Drawing Conclusions; putting it all together:**

## **Soil Mechanics**

**3(2-1)**

### **Objective:**

- Developing an understanding about the physical properties of soils and their application in agricultural engineering.

### **Contents:**

#### **Soil Formation:**

Soil and its Constituents, Weathering of Rocks and Types of Soils, Description and identification of soil (Visual-Manual Procedure), Mineralogy of Solids.

#### **Physical Properties:**

Water Content, Void Ratio, Porosity, Degree of Saturation, Specific Gravity, Unit Weight and their determination, Atterberg limits, Sieve Analysis, Hydrometer and Pipette Analysis, Stoke's Law, Grain Size distribution

#### **Classification of Soils:**

Grain Size Classification; Bureau of Soils, M.I.T. Unified, AASHTO and ASTM Classification systems. Textural Classification by Triangular Chart, Unified Soil Classification, AASHTO Soil Classifications.

#### **Permeability and Seepage:**

Definition, Hydraulic Gradient, Darcy's Law, Factors affecting Permeability, Permeability of stratified soils, Laboratory and Field determination of coefficient of Permeability, Seepage Force, Quick Sand Condition, Flow nets, Boundary Conditions, Graphical Method of Flow net construction, Determination of Quantity of Seepage, Two Dimensional Flow, Laplace Equation, seepage through Earth Dams, Design of Filters

#### **Compaction:**

Purpose and theory of Compaction, Moisture Content and Dry Density relationship, Standard Proctor Compaction Test, Modified Proctor compaction Test, Degree of Compaction and its determination in the

Field. Methods of compaction in the field; Factors affecting compaction of soils.

### **Vertical Stresses in Soils:**

Definition, Stresses caused by self-weight of soil, Geostatic stresses, stresses caused by Point Loads and Uniformly distributed Loads: Boussinesq and Westergarrd theories, Pressure bulb, Stress distribution diagram on horizontal and vertical, Stress at a point outside loaded area, Newmark's charts and 2:1 Method

### **Soil Exploration:**

Importance of Soil Exploration, Soil Exploration methods, Probing, Test Trenches and Pits, Auger boring, wash boring, rotary boring, Percussion drilling and Geophysical methods, Sol Samples, Disturbed and Un-disturbed samples, In-situ Tests (SPT, CPT and PLT)

### **Practical:**

Identification of Soil (Visual and Manual)

- ❖ Determination of Moisture Content of Soil
- ❖ Determination of Specific Gravity of Soil
- ❖ Determination of Liquid Limit of Soil
- ❖ Grain Analysis of Soil (including both Mechanical and Hydrometer Analysis)
- ❖ Determination of Plastic Limit and Plasticity Index of Soil
- ❖ Determination of Shrinkage Limit of Soil
- ❖ Classification of Soil according to AASHTO and USCS
- ❖ Modified/Proctor Compaction Test
- ❖ Constant Head Permeability Test (Granular Soil)
- ❖ Falling Head Permeability (Granular and Fine Grained Soils)

### **Recommended Books:**

1. Jumikis, A.R. 1994. Soil Mechanics, D. Van Nostrand Company Inc., Princeton, New Jersey.
2. Terzaghi, K. 1997. Soil Mechanics in Engineering Practice. John Wiley & Sons, New York.
3. Mckeyes, E. 1989. Agricultural Engineering Soil Mechanics. Elsevere New York.
4. Smith, G.N. 1990. Elements of Soil Mechanics. BSP Professional Books, Oxford.

## **Manufacturing Engineering**

**3(2-1)**

### **Objective:**

- Student's preparation in the processes required for manufacturing agricultural machines.

### **Contents:**

Turning and related operations: Lathe, construction, types of lathes, accessories, lathe operations, turret lathe; construction, types, turret lathe tooling, chip formation, mechanism of chip formation, cutting tool materials, tool failure and tool life.

Shaping and planing: shaper; classifications, functions, shaper drive mechanism, shaper speeds and machining times, planing, construction and types, work set up, planer tools, metal bending and sheet rolling processes.

Drilling and reaming: Drilling; types and sizes, drill chucks. Counter boring, counter sinking, reaming, drilling machine types, and estimating drilling time.

Milling: Definition, milling operations, milling cutters, milling machines types, size, accessories, dividing head, estimating milling time.

Gear manufacturing: Gear terminology, gear types, basic methods for machining gears.

Computer-aided manufacturing (CAM) and computer integrated manufacturing (CIM) Systems: Machine tools control, numerical control system, computerized numerical control system (CNC) programming for numerical control. Automatic machines, transfer machines, computer aided- manufacturing (CAM), computer simulation of manufacturing process and system. Automated assembly use of mechanical hands/Industrial Robots, concept of computer-integrated automation system (unmanned factory)

### **Practical:**

- ❖ Fabrication of various machine elements using lathe.
- ❖ Making a slot on a shaft for a cotter pin using shaper and milling machines
- ❖ Cutting threads using milling and lathe machines
- ❖ Making holes in machine parts using drilling machines.
- ❖ Making bends of metal sheet using sheet rolling machines
- ❖ Fabrication of a given agricultural machinery part.
- ❖ Local visits to agricultural Machinery Manufacturing Industries.

### **Books Recommended:**

1. Chapman, W.A.J. 2004. Workshop Technology Part-I.and II. Viva BooksPrivate Ltd., India.
2. Kalpakjin, S. and Schmid, R. S. 2004. Manufacturing engineering and technology.4th ed. Tata McGraw Hill Co. Ltd., New Delhi, India
3. Ostwald, P. H. and J. Munoz. 2002. Manufacturing Processes and systems. 9th edition,John Wiley and Sons, New York. USA.,
4. Rao, P. N. 2005. CAD/CAM – Principles and applications. 2nd ed. Tata McGraw Hill Co. Ltd. New Delhi, India

### **Engineering Mechanics**

**3(2-1)**

#### **Objective:**

- Teaching basic principles of force analyses in engineering systems

#### **Contents:**

Concept of measurement of mass, force, time and space, Systems of units, Fundamentals & Derived units, Conversion of units, required Accuracy of results, General Principles of Statics, Vector addition, Subtraction and Products, Resultant of Distributed (Linear & Non-linear) force Systems, General conditions of equilibrium of Co-planer forces, Laws of Triangle, Parallelogram and Polygon of forces, Types of beams, Supports and Loads, Simple cases of Axial forces, Shear forces and Bending Moment diagrams, Problem involving friction on Flat surfaces, Geometrical Properties of Plane Areas, Work, Energy, Power, Impulse, Momentum, Conservation of Momentum and Energy, Rectilinear and Curvilinear motions, Tangential and Normal Components of Acceleration, Simple Harmonic motion

#### **Practical:**

- ❖ To verify the law of polygon of forces, the law of parallelogram of forces, the principles of moments, the co-efficient of friction between surfaces. Special numerical problems and assignments
- ❖ Moment of inertia of fly wheel mounted on wall and a wooden block by suspension. Efficiency of various models of machines. Modulus of rigidity of metal bar by static and dynamic methods. Special numerical problems and assignments.



### **Books Recommended:**

1. Singer, F.L. 2000. Engineering Mechanics. Harper and Row Publishers, New York.
2. Meriam, J.L. and L.G. Kraige. 1993. Engineering Mechanics. Vol.I Statics. John Willy and Sons, New York.
3. Higdon, A. and W.B. Stile. 1986. Statics. and Dynamics. Prentice-Hall, Inc. Englewood Cliffs, N. J., USA.
4. Riley, W. & Struges, C.d. 1996. Engineering Mechanics, Static's and Dynamites, John Wiley & Sons Inc., New York.
5. Bedford, A. and Fowler, W., 1994 Engineering Mechanics: Statics: Statics and Dynamics, Addison-Wesley Publishing Company. New York.
6. McGill. D.J. and King, W.W., 1994 Engineering Mechanics: Statics and Dynamics, PWS publishing Co., New York.

### **Applied Physics**

**3(2-1)**

#### **Objective:**

- Acquaintance of students with the physics of electrical and electronic materials,
- Components, and devices.

#### **Contents:**

Electricity and Magnetism: Voltage, current, resistance, power, single phase and 3 phase A.C. supply. Series and parallel circuits. Vector addition and subtraction of A.C. voltages. A.C/D.C. motors: Concept of rotating fields, polyphase induction motor, lap and wave winding of single phase and three phase motors, torque and starting characteristics, measuring instruments, transformers. A.C power generators. Electrical distribution and wiring for farm buildings. Electric controls, motor controls, and protection. Selection of farm motors, applications of electricity at farm. Electronics: Semi-conductors, PN-junction; Transistor; its characteristics and uses; Amplifiers; Power supplies; Magnetism: Electro-Megnetic induction and radiation; Radioactivity: Radio isotopes; Biological effects of radiation; Laser: Introduction, generation and uses of Laser. Fiber optics–characteristics.

#### **Practical:**

- ❖ Construction of wiring systems, fuses, switches of various types insulators

- ❖ Circuits design and drawing of a typical farm electrical system.
- ❖ Selection of motor for various farm equipment such as forage cutter, feed-grinders, and shop tools.
- ❖ Practice on repair and adjustment of electric motors, switches, fuses, transmission wiring controls
- ❖ Study of 3 phase induction motor
- ❖ Study of star and delta connections
- ❖ Study of semi conductor, triode, diode valve and transistors.
- ❖ Use of AVO meter, CRO, plani meter
- ❖ Fabrication of full wave rectifier and inductance study of its wave-shape.
- ❖ Measurement of self-inductance and mutual inductance

### **Books Recommended:**

1. Theraja, B.L. 2004. A Text Book of Electrical Technology. S. Chand & Co. Ltd. New Delhi, India.
2. Cotton, et al. 1995. Electrical Tech. Pitman and Sons. London.
3. Fitzgerald, A.E. 1994. Basic Electrical Engineering. McGraw Hill, New York.
4. Hammond, P. 1979. Electromagnetism of Engineers. Pergamon Press, New York, USA.

## **SEMESTER - 3**

### **Differential Equations, Power Series**

**3(3-0)**

#### **Objective:**

- To introduce basic technology pertaining to formulation / solution of differential equations and power series.

#### **Contents:**

#### **Ordinary Differential Equation:**

Basic concepts of ordinary differential equation, General and particular solution, Initial and boundary condition, Linear and nonlinear differential equations, Solution of first order differential equation by separable variables and its application in our daily life situations, Techniques like change in variables homogeneous, non-homogeneous, exact, non-exact, linear and non-linear Bernoulli could be used in case of complications. Solution of second order differential equations by theory of operators and its application as forced and free oscillations, the extension of second

order solution criteria to high order differential equations, solution of the system of differential equations by theory of operators and its application in daily life situations.

### **Partial Differential Equations:**

Basic Concepts, linear and non-linear P.D equations, Quasi linear and Quasi non-linear P.D equations, homogenous and non-homogenous P.D equations, solutions of P.D equations, boundary and initial conditions as dirichlet conditions, Neumann' s condition, Robbin's/mixed condition, classification of P.D equations as Elliptic conditions, Parabolic and hyperbolic.

Analytic Solution by separation of Variables of the Steady State, two dimensional heat equation/Laplace equation and un-steady one dimensional heat equation/Diffusion equation with homogenous and non-homogenous boundary conditions. D'Alembert's solution of two dimensional wave equation homogenous and non-homogenous boundary conditions.

### **Fourier series:**

Periodic waveforms and their Fourier representations, calculating a Fourier series, Fourier series of odd and even functions, Half range Fourier series, Fourier series solution for the above P.D equations.

### **Recommended Books:**

1. Kreyszig, E. 1999. Advanced Engineering Mathematics. John Wiley and Sons, New York.
2. Yousaf, S.M. 1998. Mathematical Methods, Ilmi Kitab Khana Kabir Street, Urdu Bazar, Lahore.
3. Sharma, G.S., K.L.Ahuja and I.J.S. Sarna.1988. Advanced Mathematics for Engineers and Scientists. Tata McGraw Hill Co., India

## **Engineering Thermodynamics**

**3(2-1)**

### **Objective:**

- To give basic understanding of the subject to undergraduate students for Agriculture power units and machines.

## Contents:

Heating and expansion of gases. Units of heat, gases and vapours, constant volume and constant pressure, P-V diagram, specific heat of gases, internal energy of gas, law of conservation of energy, methods of heating and expanding gases and vapours, work done by gas in expanding.

Laws of perfect gases: The two laws of thermodynamics, the heating of gases, equations for different types of heating methods.

Air cycles: Cycles of operation, air standard efficiency of a cycle, reversible process, reversible cycles, reversibility and efficiency, Carnot cycle, Otto cycle, diesel cycle, mean effective pressure.

Entropy of gases: Entropy and heat, T-S diagrams, Carnot, Otto, diesel and dual combustion cycles on T-S diagrams.

Air compressors: functions, compressor types, reciprocating and rotary compressors, single and multistage compressors, cylinder clearance, work done, compressor efficiency.

Compound expansion: advantages of compound expansion, tandem type of two-cylinder compound engine, receiver type compound engine; combined indicator diagram for compound engine, Calculations for cylinder uniflow engine.

Fuels: Combustion of fuels, properties of fuels – viscosity, pour point, flash point, calorific value, API gravity, conversion of volumetric analysis, analysis by weight, weight of carbon in burnt gases, weight of air required for complete combustion of fuel, weight of flue gases per pound of fuel burnt, weight of excess air supplied, method of analyzing flue gases, heat carried away by flue gases, volumetric analysis of a gas, air fuel ratio for I.C. Engine.

Refrigeration: Co efficient of performance, units of refrigeration, air compression refrigeration, vapour compression refrigeration, refrigeration cycles, rating, quality of refrigerant and general considerations, components of refrigeration system, heat pumps.

## Practical:

- ❖ Study of working principles of two stroke and four stroke engines using models.
- ❖ Demonstration of Joule's law.
- ❖ Study of rotary and reciprocating air compressors and their characteristic curves.
- ❖ Study of PV diagram of diesel/gasoline engines.
- ❖ Analysis of engine flue gases for CO, CO<sub>2</sub>, NO<sub>2</sub>, etc.
- ❖ Determination of energy content of different fuels using calorimeter.
- ❖ Study of heat transfer using refrigeration and air conditioning cycle.

- ❖ Measurement of fuel viscosity using viscometer.
- ❖ Determination of flash point and fire point of different petroleum products.

### **Books Recommended:**

1. Khurmi, R.S. and J.K. Gupta. 2000. Thermal Engineering. S. Chand & Co. Ltd., New Dehli, India.
2. Sonntag, R. E. and G. J. Van Wylen. 2003. Fundamentals of thermodynamics. 6th ed , John Willey and Sons, Inc. New York, USA.
3. Jones, J.B. and Hawkais, G.A.2002. Engineering Thermodynamics. John Willey and Sons, Inc. N.Y., USA.
4. Lewitt E. H. 2002. Thermodynamics applied to heat engines, Issac Pitman and Sons, London.
5. Eastop, T. D. 2004. Applied thermodynamics for engineering and technologists. 5th Ed. Pearson Education Singapore

## **Engineering Hydrology**

**3(2-1)**

### **Objective:**

- To acquaint the students with the basic components hydrologic cycle and their analysis.
- Introduce a stream flow components, flood routing, and hydrology model.

### **Contents:**

Hydrologic processes: Introduction, Hydrologic cycle and its components, importance of hydrology, climatic factors, estimation of precipitable water, snowcover and snow fall, stream flow, water stage, discharge, interpretation of stream flow data evaporation and transpiration, Evapotranspiration and its estimate using different methods.

Hydrologic Analysis: Hydrograph and its characteristics, run off and its components, recessions, hydrograph separation, rainfall-runoff relations, phenomenon of runoff estimating the volume of storm runoff, estimating snow melt runoff, seasonal and annual runoff relations, hydrograph of runoff unit hydrograph its derivation and application, overland flow.

Hydrologic routing: Introduction, river routing level pool routing, linear reservoir model, Muskingam method.

Hydrologic Models: definition, classification of models, development, calibration, verification and application of models.

**Practical:**

- ❖ Demonstration of weather recording instruments and practice in taking actual data from weather stations including a visit to weather station.
- ❖ Measuring runoff in the field by different techniques.
- ❖ Development of unit hydrograph and its use.
- ❖ Frequency analysis of rainfall data.
- ❖ Measuring infiltration rate in the field.

**Books Recommended:**

1. Awan, N.M. 1981. Surface Water Hydrology, National Book Foundation, Islamabad.
2. Linsely, R.K., Kohler, J.L.H. Paulhyus 1996. Hydrology for Engineers, SI. Edition, McGraw Hill Kogakusha Ltd.
3. Ward, R.C., Robinson, M. 1990. Principles of Hydrology, McGraw Hill Book Co., London.
4. Wilson, E. M. 1990. Engineering Hydrology, Macmillan Civil engineering hydraulics.N.Y.

**Surveying and Leveling**

**4(2-2)**

**Objective:**

- To enable students to understand theory and practice of land surveying and leveling.
- To develop skills to use modern survey instruments for above objective.

**Contents:**

**Introduction:**

Surveying instruments; Chains, Tapes, Steel Bands, their Types and Uses

**Chain Surveying:**

Ranging and chaining of survey Lines. Fieldwork and plotting of chain survey.

**Compass Surveying:**

Prismatic Compass and Surveyor Compass, Uses, Bearing, Local Attraction, Fieldwork and Plotting

**Plane Table Surveying:**

Parts and Accessories, Methods of Surveying, Two Point and Three Point Problems

**Leveling:**

General Principle, Types of Levels and their temporary and Permanent Adjustments, Methods of Leveling, Reduction of Level, Precise Leveling and Trigonometric Leveling

**Theodolite:**

Types and uses of Theodolites, Temporary and Permanent Adjustments, Measurement of Horizontal and Vertical angles

**Tachometrical Surveying:**

Methods of Tachometric Surveying. Fieldwork and computations.

**Traversing:**

Traversing with Prismatic Compass, Theodolite and Plane Table, Computations and Adjustments of Traverse, Transformation of Co-ordinates

**Omitted Measurements****Calculation Of Areas And Volumes:**

Earth work calculation, D.M.D method, Simpson rule and Trapezoidal rule

**Practicals:**

- ❖ Practice on measurement of distances and introduction to measuring instruments
- ❖ Chain Surveying and plotting
- ❖ Compass Traversing
- ❖ Plane Table by methods of radiations and intersections
- ❖ Two Points Problem
- ❖ Three Points Problem

- ❖ Level adjustments by Two-Peg method
- ❖ Profile and Cross-Sectioning
- ❖ Theodolite Traversing

### **Books Recommended:**

1. Brinker, A.C. and Taylor, W.C. 2002. Elementary Surveying. International Text Book Co. Scranton, Pennsylvania, USA.
2. Ramsay, J.P. Wilson. 2000. Land Surveying. Macdonald and Evans Ltd. Estover, Plymouth PL 6 7PZ.
3. Clark, David. 1989. Plane and Geodetic Surveying for Engineers Vol. I. Constable and Co. Ltd. London, England.

## **Computer Programing and Applications in Engineering 3(1-2)**

### **Objective:**

- Students preparation in computer programming and its applications in engineering.

### **Contents:**

Introduction: Computer components, operating system, software & applications Programming: Introduction, programming languages, flowchart, programming structure, introduction to C<sup>++</sup>, application of C<sup>++</sup> to solve engineering problems, modeling and simulation.

### **Practicals:**

- ❖ Demonstration of computer components and Windows installation.
- ❖ Exercise on the use of word processing, spreadsheet and engineering graphics.
- ❖ Programming of engineering problems with C<sup>++</sup>.

### **Books Recommended:**

1. Perry, G. and M.Johnsons. 1992. Turbo C<sup>++</sup> by Examples. Prentice Hall Computer Publishing, New York.
2. Shelly and Cashman. 1996. Using Computer, a Gateway to Information. Boyd and Fraser Publishing Company, USA.



## SEMESTER - 4

### Numerical Analysis

3(2-1)

#### Objective:

- To introduce various techniques for solving Linear, non linear and difference equations using various numerical methods.

#### Contents:

Finite difference, Forward, backward and central difference and its operators form, Interpolation and extrapolation; Linear and higher order interpolating polynomials, Newton's Gregory forward & backward difference interpolation formulas and its utilization as extrapolation, Lagrange interpolation and extrapolation, Numerical differentiation based on differences, Numerical integration; Trapezoidal and Simpson's approximations, Trapezoidal and Simpson's extrapolations by Romberg integration process, Numerical Solution of non-linear equations; Bracketing and iteration methods and its applications as multiple root methods, Direct solution of the system of linear equations; Gauss-elimination, Direct and indirect factorization, symmetric factorization, tridiagonal factorization, Iterative methods like Jacob's iteration and Gauss-Seidel iteration, Numerical solution of initial value problems; Single-Step methods like Euler's method, Euler's modified method, Runge-Kutta method and its comparison with Taylor's series expansion, Multi-steps methods like Adams Bashforth and Moulton two and three step methods, Higher order differential equations, system of differential equations, Numerical solution of linear and nonlinear boundary value problems.

#### Recommended Books:

1. Numerical Methods for Engineering Science and Mathematics, 2<sup>nd</sup> Edition by Prof. Mumtaz Khan, Dec.
2. Ordinary & Partial Differential Equations with Numerical Techniques for Engineering Science and Mathematics, 2<sup>nd</sup> Edition by Prof. Mumtaz Khan, April

### Open Channel Hydraulics

3(2-1)

#### Objective:

- To study the basic concepts of fluid flow, principles of energy and momentum, and characteristics of different hydraulic structures used in open channel.

## **Contents:**

### **Basic Concepts of Fluid Flow:**

Types, state and regimes of flow, channel flow types, channel geometry, measurement of velocity in channel, velocity distribution in channel and its coefficients, pressure distribution in channel, effect of slope on pressure distribution.

### **Energy and Momentum Principle:**

Basic equations, specific energy, specific energy and alternate depths, E-Y relationship, criteria for a critical state of flow, computation of critical flow, control of flow, application of flow control in rectangular channel, momentum in open channel flow, specific momentum, hydraulic jump, M-Y relationship.

### **Uniform Flow:**

Establishment of uniform flow. The Chezy's and Manning's equations, resistance coefficient estimation, normal depth and velocity, normal and critical slopes, free board, best hydraulic section, determination of section dimensions.

### **Rapidly Varied Flow:**

Characteristics of varied flow, sharp crested weir, aeration of the nappe crest shape and discharge over spillway, type and characteristics of the hydraulic jump, jump as energy dissipater, flow through sudden transitions.

### **Practical:**

- ❖ Determination of discharging in open channel through different methods.
- ❖ Development of stage-discharge curve (Y-Q Relationship)
- ❖ Development of hydraulic jump
- ❖ Flow through/over different hydraulic structures
- ❖ Determination of critical flow, critical depth, alternative depth
- ❖ Determination of Chezy and Manning n for a rectangular prismatic channel
- ❖ Plotting flow profile of an open channel

### **Recommended Books:**

1. Chow, V.T. (1990). Open Channel Hydraulics. McGraw Hill International Book Company.
2. French, R. H. (1996). Open Channel Hydraulics, McGraw Hill International Book Company.

- Henderson, F.M. (1990). Open Channel Flow. McMillan Publishing Co.

## **Farm Power**

**4(3-1)**

### **Objective:**

- Providing instructions relating components of I.C. engine, tractor components and its mechanics

### **Contents:**

Introduction: History of engine development, engine cycles, principles of operation, types of engines.

Principal parts of engine: Functions, construction, cylinder, cylinder heads, liner, crank case, piston, connecting rod, crank shaft, clutch, flywheel, valves and their operation, valve mechanism.

Fuels and combustion: Types of engine fuels, fuel tests and their significance, gasoline tests, antiknock test, octane number, volatility, Reid vapour pressure, sulphur content, gun content, heat values, gasoline additives. Engine emissions and their analysis.

Fuel System: major components of fuel systems (petrol / diesel), carburettor, fuel injection pump, injector/nozzles, electronic fuel injection, governing system, trouble shooting, calibration of fuel injection pump.

Ignition system: Types of ignition, spark, magneto and compression ignition, induction coils, distributor, spark plug, contact-breaker points, condenser, trouble shooting.

Cooling system: Types, principle of operation, parts of air/water cooling system, line diagram, radiator, thermostat, water pump, fan, engine heating, repair and maintenance, types of coolants.

Lubrication system: Types, principle of operation, components of lubrication systems, line diagram, types of lubricants, trouble shooting.

Electrical System: A.C. and D.C. voltage, alternator/dynamo, battery, battery charging and maintenance, self starter, electrical gauges and controls, line diagram, repair and maintenance.

Intake and exhaust system: Air intake system, air cleaner, supercharger, turbo charger, inter-cooling, and construction of intake and exhaust manifolds, mufflers, flue gases.

## **Mechanics of the Farm Tractor Chassis:**

Force Analysis, Soil reaction, Draw bar pull, Stability of tractors, Tipping and lateral stability

Clutch and Brakes

Transmission, Differentials, Power take-off, Pulley drives, Power lift and hydraulic controls. Tractors tests and performance

Farm Management

Farm planning for efficient use of resources and attainment of business goals and farm accounting.

### **Practical:**

- ❖ Study of main components of engine and engine types.
- ❖ Study of valve system and its adjustments.
- ❖ Demonstration of fuel system, cooling system and electrical system of tractor.
- ❖ Measurement of air pressure/air fuel ratio in each cylinder of engine.
- ❖ Fuel injector, pump adjustment and calibration.
- ❖ Demonstration of engine lubrication system.
- ❖ Servicing of a single cylinder diesel engine.
- ❖ Removal of air lock of a diesel engine.
- ❖ Battery testing for charging/discharging.
- ❖ Engine diagnostics-analysis of engine emissions using gas analyzer, multi-scan, etc.
- ❖ Tour to tractor industry (Millat Tractors Limited, Al-Ghazi Tractors, Ltd)

### **Books Recommended:**

1. Single, R.K. 2004. Internal Combustion Engines. S.K. Katana & Sons, Dehli, India.
2. S.C. Jain and C.R. Rai. 2000. Farm Tractor Maintenance and Repair, Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Halderman, J. C. D. Mitchell. 2005. Automotive Engines: theory and servicing. 5th ed. Pearson Prentice Hall, Singapore.
4. Promersberger and Bishop. 1996. Farm Power. Prentice Hall Inc. Englewood Cliffs, New Jersey U.S.A
5. Paul W.G. James, H. Smith Jr and E.J. Ziruy. 1995. Fundamentals of Internal Combustion Engines, 4th Ed. Oxford & IBH Publishing Company (Pvt) Ltd. New Dehli.

## **Mechanics of Materials**

**3(2-1)**

### **Objective:**

- Developing an understanding of design of building and machine elements from stress – strain standpoint.

### **Contents:**

Stress and strains: Stress at a point, components of stress, analysis of plane stress, principle stresses, maximum shear stress, Mohr's circle.

Axial loading: Stress due to axial forces, strain, properties of material under axial loading.

Bending: Bending stresses in beams, shear and bending moment diagrams.

Combined loading: Stresses due to axial, bending and torsional loading.

Deflection: Moment-curvature relationship, deflection of beams by the method of double integration.

Deflection of beams: Double integration method with singularity function, area moment method, Torsion: Shearing stress and angle of twist, hollow and circular shafts.

Buckling: Pin ended column, eccentrically loaded column, initially curved column, critical loads and critical stresses.

Curved beams: Stresses in curved bars. Cylinders and spheres: Stresses in thin and thick walled cylinders. Fatigue loading: analysis and design.

### **Practical:**

- ❖ Practical exercises related to axial loading, bending torsion and deflection of beams. buckling, curved bars, strain gauges and fatigue loading. Special numerical problems and assignments.

### **Books Recommended:**

1. Muvdi, B.B. and J.W. McNabb. 2001. Engineering Mechanics of Materials. Macmillan Publishing Co. New York.
2. Shigley, J.E. and Mitchell, L.D. 1983. Mechanical Engineering Design. McGraw Hill Book Co. New York.

## **Farm Structures & Materials**

**3(2-1)**

### **Objective:**

- To develop ability of students to understand and carry out specified farm structure

- To familiarize about the characteristics of material used in agricultural engineering related structured

### **Contents:**

#### **Heat flow through Walls Insulation:**

Rate of heat transmission through building materials, conductance, combined conductance coefficient, Equation for heat flow through non-homogenous walls, combined ceiling and roof coefficient.

#### **Ventilation:**

Air flow and quantity of moisture, Air flow required in heat transfer, Estimating Air flow required to prevent condensation, Air flow required to maintain prescribed chemical composition, Heat balance equation, Exposure ratio, Ventilating systems, Ventilation by Wind forces, Stack ventilation Systems, Construction practices, Forced draft systems.

#### **Dairy Building:**

Functional planning, Environment, Sanitation, Space requirements for animals and traffic, arrangement of space, Other considerations, Milking Parlors, Pen vs Stall Barns, Storage or feed, Milk and manure etc, Insulation and ventilation.

#### **Poultry Housing:**

Functional planning, Production practices, Environment, Space requirements, Arrangement or space, Insulation and ventilation, other considerations.

#### **Storage Of Fruits And Vegetable Crops:**

Condition for storage, Refrigerated vs Common Storage, Economic aspects of storage, Characteristics of Common storage, Refrigerated storage, Refrigerating Load, Modified Atmosphere Storage, Types of Evaporators, Coil Temperature vs Relative Humidity and Equipment capacity, Air movement, Storage management.

#### **Storage Of Grains:**

Destructive agents, Respiration of grains, Indices of quality, Moisture and Temperature changes in stored grains, Moisture properties of grains, Functional requirements, Conditioning moist grains, Storage structure, Equipment for grain handling and processing.

**Recommended Books:**

1. Barre, H. J., and Sommet, L. L. Farm Structure. John Wiley and Sons., Inc, New York, USA.
2. Barnes, Amaurice M. and Mander Clive, 2000. Farm Building Construction. Farming Press, England
3. Gray Horrold, E. 1985. Farm Service Building. McGraw Hill Book Company, New York
4. Neubauer, L.W. and Walker H.B. 1981. Farm Building Design. Prentice Hall Inc., Englewood Cliffs, N.J.
5. Haider, S.Z. 1985. Materials of Construction. Oxford University Press, Pakistan.

**Soil Science****3(2-1)****Objective:**

- Developing understanding of basics of soils in agricultural engineering perspective.

**Contents:****Soil Perspective:**

What is soil? Edaphology and Pedology, A field view of soil, Soil profile, Subsoil and Surface soil, Mineral vs. Organic soils. Four major Components of Soils, Mineral constituents in soils, Soil organic matter, Soil water, Soil air, clay and humus.

**Important Physical Properties of Mineral Soils:**

Soil texture and Soil Structure, Classification of soil particles, Physical nature of soil separates, Soil texture classes. Mechanical analysis, Preparation of the Sample, Factors affecting dispersion, Methods for obtaining dispersion, Fractionation of the sample, Sieve method. Stokes' Law. Sedimentation methods, Determination of soil class, Particle and Bulk Density, Pore Space, Structure of mineral soils, Aggregation and its promotion, Structural management of soil, Soil Consistence.

**Soil Colloids:**

General constitution of Silicate clays, Adsorbed cations, Silicate clay structure, Classification of Silicate clays, Chemical Composition of silicate clays, Cation exchange capacity of soils, Plasticity, Cohesion, Swelling, Shrinkage, Dispersion and Flocculation.

**Soil Water:**

Structure and related properties of water, Soil water energy concept, Soil Moisture content versus Suction, Measuring Soil moisture, Capillary Fundamentals, Types of soil water movement, Saturated flow through soils, unsaturated flow in soils, Retention of soil moisture in the field, Conventional soil moisture classification, Factors affecting amount and use of available soil moisture, Capillarity and root extension.

**Soil Air and Soil Temperature:**

Soil aeration definition, soil aeration problems in the field, Composition of soil air., Factors affecting the composition of soil air, Fick's Law, Aeration in relation to soil and crop management. Soil temperature, Specific Heat of soils, Volumetric Heat Capacity, Thermal diffusivity, and Conductivity, Fourier's Law, Movement of Heat in soil, Soil temperature control.

**Plant Nutrients and Fertilizers:**

Factors controlling the growth of higher plants, The essential elements from air, water and soil, Soil solution, Soil and plant interrelations, fertilizer elements, Nitrogen Fertilizers, Phosphates Fertilizers, Potassium Fertilizers, Mixed Fertilizers, Methods of applying solid fertilizers, Application of liquid Fertilizers.

**Saline and Sodic Soils:**

Climate and salinity, Some basic terms, Saline, Saline alkali and Sodic Soils, Diagnosis of Saline and Sodic Soils, Reclamation Steps of Salt-affected soils, Leaching Requirements, Crop tolerance to Salinity.

**Recommended Books:**

1. Brady, N.C. (2008). The Nature and Properties of Soils (14<sup>th</sup> Edition). Macmillan Co. Ltd. USA.
2. Rashid, A. and K. S. Memon. (1996). Soil Science. National Book Foundation, Islamabad.
3. Tanji, K.K. 1990. Agricultural salinity assessment and management. ASCE No.71, New York, USA.
4. Gupta, I.C. 1990. Use of saline water in Agriculture. Oxford and IBH Pub. Co., New Delhi, India.



## SEMESTER - 5

### Communication & Presentation Skills

3(2-1)

#### Objective:

- To enable the students to meet their real life communication needs

#### Contents:

The nature of communication & communication in an organization ,Power Point Presentations

Oral presentations, Persuasive presentations, Resumes and Covering letters, Interview taking, Meetings, Negotiation Skills, Team Communication, Debate, Persuasive Presentations on Research Report, Listening ( audio aids TOEFL & IELTS Practice Tests),Business letters, memos and minutes, Writing and Presenting Proposals, Class Presentations, Class Presentations

#### Assignments To Be Given During The Course:

Letter writing , Resume and Covering Letter, Proposal, Team Writing, Sales brochure, Collecting ads

#### Books Recommended:

1. Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top
2. Hargie, O. (ed.) Handbook of Communications Skills
3. Mandel, S. 2000. Effective Presentation Skills: A Practical Guide Better Speaking
4. Mark, P. 1996. Presenting in English. Language Teaching Publications.

### Statistics & Probability

3(2-1)

#### Objective:

- The basic concepts of application of probability and statistics in the agricultural engineering

**Contents:****Statistics:**

Mean value, Measures of central tendency, Measures of variation, Standard deviation, Expected value of a random variable, Standard deviation of a random variable, The Poisson distribution, The uniform distribution, The exponential distribution, The normal distribution, The standard normal, The standard normal distribution.

**Probability:**

Sets, Application of Venn Diagrams, Introducing probability, Mutually exclusive events, The addition law of probability, Complementary events, Concepts from communication theory, Problems related to engineering, Conditional probability, The multiplication law, Independent events, Baye's formula, Permutations and combinations, Multiplication principle, Problems related to engineering, science and management, Applications of counting, Bernoulli trials, Binomial probability, Markov chains, Probability distribution, Expected value, Decision making, Problems related to engineering and management.

**Practical:**

- ❖ Simple, Multiple and Component bar diagram.
- ❖ Histogram, Frequency polygon, Frequency curve, c.f. curve, cumulative percentage curve and locate Quantiles.
- ❖ Problem assignments relating probability
- ❖ Fitting a Binomial distribution.
- ❖ Fitting a Poisson distribution.
- ❖ Fitting a Normal distribution.
- ❖ Sampling distribution of difference between two means.
- ❖ Application/use of t-test for Null hypothesis
- ❖ Test of significance of association of attributes by  $\chi^2$ -test (chi-square test).
- ❖ Testing goodness of fit.
- ❖ Calculating a simple, partial and a multiple correlation and their tests of significance.
- ❖ Fitting a simple linear regression equation and its test of significance by Analysis of Variance (F-test) and t-test.
- ❖ Analysis of variance of data from C.R.D., R.C.B.D. and L.S. design.

**Recommended Books:**

1. Blind, D.A. & R.D. Mason, Basic Statistics for Business & Economics, Irwin Publishers

2. Choudhry, S.M. and S. Kamal. 1998. Introduction to Statistical Theory Part I & II; Ilmi Kitab Khana, Kabir Street, Urdu Bazar, Lahore
3. Erwin Kreyszig, Advanced Engineering Mathematics 8<sup>th</sup> Edition, John Wiley & Sons Publication
4. Lester D. Taylor. 1974. Probability and Mathematical Statistics. Harper & Row, Publishers New York.
5. Miller I. and John E. Freund. 1985. Probability and Statistics for Engineers. Prentice Hall, Inc., Englewood Cliffs, New Jersey.
6. Muhammad, F. 1999. Statistical Methods and data analysis; Kitab Markaz, Bhowana Bazar, Faisalabad, Pakistan.
7. Ronald E. Walpole. 1982. Introduction to Statistics; McMillan publishing Co., Inc. New York. 10022.
8. Walpole R.E. (1982). Introduction to Statistics, McMillan publishing Co, Inc. new York

## **Irrigation Engineering**

**3(2-1)**

### **Objective:**

- To enrich the students with the importance, development and management issues of irrigation network of Pakistan
- Application of various field application methods, design of irrigation channels through different approaches.

### **Contents:**

#### **Introduction:**

Definition, necessity of irrigation, water resource and irrigation system of Pakistan, Indus Basin Treaty, water budget of Pakistan

#### **Water Requirement Of Crops:**

Functions of irrigation, preparation land for irrigation, crop period, base period, duty and delta, relationship between duty and delta, factors affecting duty, depth and frequencies of irrigation, Kharif-Rabi ratio, optimization of irrigation water, irrigation efficiency, uniformity coefficient, consumptive use of water, effective rainfall, net irrigation requirements, gross irrigation requirement, estimation of consumption use, Blaney Criddle, Hargreaves Methods, assessment of irrigation water wharges

### **Methods of Irrigation:**

Classification of irrigation methods, factors affecting the choice of irrigation methods, surface methods, sub-surface irrigation methods

### **Hydraulic Structures:**

Introduction: Dams, weirs, and barrages. Classification of dams, Gravity dams, Forces acting on a gravity dam, Modes of failure, Principal and shear stresses, Stability analysis, Elementary profile of a gravity dam, Practical profile of a gravity dam, Limiting height of a gravity dam, Profile of high masonry gravity dam.

### **Water Conveyance Structures:**

Introduction: Canals, distributaries, minors, and water courses. , Basic definitions, alignment of canal, water distribution system, required canal capacity, seepage losses, empirical formula for channel Losses, channel section for minimum seepage losses.

### **Design of Irrigation Channels:**

Design of stable channel, regime channels, Kennedy's theory, Lacey's theory, estimation of transported sediment, bed load equations, design procedure for unlined non-erodible irrigation channel, maintenance of irrigation channels

### **Practical:**

- ❖ Study of characteristics of various irrigation structures in the near by area.
- ❖ Design and layout of a canal for a given command.
- ❖ A field visit to canal irrigation system and structures.
- ❖ Design of outlets.
- ❖ Computer aided design of a watercourse for a command area.
- ❖ Sampling and measurement of sediments in canal water.

### **Recommended Books:**

1. Irrigation Engineering & Hydraulic Structures by Santosh Kumar, Garg, 10th revised Edition, 1993
2. Irrigation & Water Power Engineering by Dr. B.C. Punmia, Dr. Pande B.B. Lal
3. Siddiqui, I. H. 2003. Irrigation and Drainage Engineering. Royal Book Company, BG-Rex Centre Fatima Jinnah Road, Karachi.

4. Iqbal Ali. 2001. Irrigation Engineering, Oxford University Press, London.
5. Withers, Bruce & Vipond, S. 1980. Irrigation Design and Practice, Batsford Academic and Education Limited London.
6. Aisenbrey, A.J., Hayes, R.B., Warren, H.J., and Young, R.B., 1983. Design of small canal structures, USBR, Denver Colorado, USA.
7. Ahmad, N. and Chaudhry, G.R. 1988. Irrigated Agriculture of Pakistan, Shahzad Nazir Publisher, Gulberg-III, Lahore.
8. Ahmad, N. 1993. Water Resources of Pakistan, Shahzad Nazir Publisher, Gulberg-III, Lahore.
9. Michal, A.M. 2003. Irrigation Theory and Practice, Vikas Publishing House (Pvt) New Delhi, India. Arora, R.K. Irrigation and Water Power Engineering.

## **Machine Design**

**3(3-0)**

### **Objective:**

- Discussion of design and loading of Power Transformers and Induction motors is introduced and electrical equipment installation; commissioning, testing and troubleshooting practices are discussed.

### **Contents:**

#### **Introduction:**

Meaning of Mechanical Engineering Design, Phases of design, Design considerations, Safety and product reliability, Codes and standards, evaluation and presentation

#### **Design Of Simple Machine Components:**

Design of shafts, torsion of circular shafts, horsepower transmitted by the shafts, design of clutches, bearings, gears, flange couplings, pulleys and connecting rod

#### **Design of Fasteners And Connections:**

Different types of fasteners. Thread standards and definitions, Mechanics of power screws. Bolts strength and selection of units, Bolt preload, torque requirement, Bolted, riveted and welded joints loaded in shear, Keys pins, and retainers

## **Elements of Rotary Power Transmission:**

Belts, Stresses in belts, Chain and sprocket drives, Gears drives, Flexible shafts, Bearings

## **Recommended Books:**

1. Shigley, J.E. and C. R. Mischhe, (2000). Mechanical Engineering Design. Fifth Edition. McGraw Hill Publications Inc. USA.
2. Parkinson, A.C. (1968). A First Year Engineering Drawing, sixth Ed., Sir Issac Pitman & Sons Ltd. London.
3. Spotts, M.F. (1978). Design of Machine Elements. Englewood Cliff Prentice Hall, London.

## **Bio-Environmental Engineering**

**3(2-1)**

### **Objective:**

- Teaching various aspects of environmental science and engineering.
- To familiarize students with the basic principles of environmental engineering.

### **Contents:**

Basic definitions, Importance of environmental control in agriculture, Pollution and their classification, Environmental monitoring and control.

### **Water Pollution:**

Irrigation water quality, criteria and standard. Sources and types of pollution, agricultural practices and water pollution, solute transport phenomenon, judicious use of water to avoid leaching, land and water management techniques for controlling water pollution, subsoil contamination

### **Air Pollution:**

Types of air pollutants, sources of air pollution, global warming, ozone depletion, hazardous substances, World's carbon pollution. Horizontal and vertical dispersion of pollutants, cleaning the atmosphere, measurements of particulates, gases and their control.

### **Noise Pollution:**

Sound pressure level, frequency and propagation, Acoustic environment and health effects of noise, measuring noise, noise control.

### **Practical:**

- ❖ Measurements of pH, colour, odour, BOD, COD, solids, nitrate of water and waste water etc.
- ❖ Design of Green House and Plant Environment Control System.
- ❖ Measurement of dust and fume in the air.
- ❖ Measurement of noise level.
- ❖ Case studies exercises and assignments.
- ❖ Total coliform test in drinking water by multiple fermentation tube method.

### **Recommended Books:**

1. Agarwal, S.K. 2002. Pollution Management V Noise Pollution.
2. Basak, N. N. 2003. Environmental Engineering.
3. Bhatia, S.C. 2001. Environmental Pollution Control in Chemical Industries.
4. Henry, J.G. and Heinke, G.W. 1989. Environmental Science and Engineering. Prentice Hall Ltd., N.J., USA.
5. Khandela, M.C. 2004. Environmental Protection & Development
6. Kumar, A. 2004. Industrial Pollution and Management
7. Masters, G.M. 2004. Introduction to Environmental Engineering.
8. Neelima R. and D.K. Markandey. 2005. Environmental Analysis and Instrumentation.
9. Pandey, G.N. and G.C. Carney. 1992. Environmental Engineering. Tata McGraw Hill Publishing Company Limited, New Delhi.
10. Rajvaidya. N. and D.K. Markandey. 2005. Environmental Pollution Control.
11. Shrivastava. K. K. 2004. Environmental Education Principles, Concepts and Management.
12. Vesilind, P.A. J.J. Peirce and R.T. Weiner. 1990. Environmental Pollution and Control. Butterworth-Heinemann, London.
13. Wall, J.D. 1980. Environmental Management Hand Book. Welf Publishing Co., London, Tokyo.

### **Instrumentation and Measurements**

**3(2-1)**

### **Objective:**

- Preparing students for automatic control of systems and machines.

## **Content:**

Basic terminology and concepts related to instruments Instrument behaviour application of instrumentation, functional elements of instruments, basic terms related to instrumentation, such as threshold, resolution, accuracy, precision, sensitivity, response and error of instrument, uncertainty analysis, least square techniques, static and dynamic characteristics of instrumentation, signal conditioning and recording devices.

Principles and Theory of Electrical Instruments: Potentiometer, wheat stone bridge. Strain analysis; strain measurement; strain gauges, types and their applications.

Displacement, Velocity and Acceleration Measurement: Sensors and transducers, displacement measurement sensors; potentiometer, LVDT, capacitance sensors, piezoelectric sensors. Velocity and acceleration sensors.

Force and Torque Measurements: Force Measurements; Load cells. Torque measurements; torque cells. Pressure Measurement: Gauge, vacuum and absolute pressure, pressure measuring devices. Measurement of Temperature: Resistance thermometers, thermocouples and radiation methods. Fundamentals of mechatronics: Introduction to electronics and sensors used in agricultural machinery, interfacing the machine and computers for response, controls and data logging, computer simulation of mechanical system.

## **Practical:**

- ❖ Measurement of Displacement by LVDT and Potentiometer.
- ❖ Measurement of wind velocity.
- ❖ Measurement of Force by Strain Gauges.
- ❖ Calibration of pressure gauges with dead weight tester
- ❖ Measurement of Temperature by thermocouples.
- ❖ Computer inter-facing for the depth and draft controls of tractors.
- ❖ Visit to Mechatronics labs of different institutions.
- ❖ Study of depth sensors in Agricultural Machinery

## **Books Recommended:**

1. Neculescu, D. S. 2002. Mechatronics, Prentice Hall Inc., N.J., USA.
2. Figliola, R. S. and D. E. Beasley. 3rd ed. 2004. Theory and design for Mechanical measurements. John Willey & Sons (Asia) Pte, Inc. Singapore



3. Dally, J. W. W. F. Riley and K. G. McConnel. 2003. Instrumentation for engineering measurements, 2nd ed. John Willey and Sons, Inc. Singapore
4. Shetty, D. and R. A. Kolk. 2001. Mechatronics system design. Vikas Publishing House,Pvt, Ltd. New Delhi, India
5. Mahalik, N. P. 2003. Mechatronics, principles, concepts and applications. Tata McGraw Hill, New Delhi, India

## **SEMESTER - 6**

### **Professional Ethics 2(2-0)**

#### **Objectives:**

- The objective of the course is to improve the ethical standards of students in engineering.

#### **1. Engineering Ethics:**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas. Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories

#### **2. Engineering as Social:**

Engineering as experimentation – Engineers as responsible experimenters – Codes of Ethics – A Balanced Outlook on Law – The Challenger Case Study.

#### **3. Engineer’s Responsibility for Safety:**

Safety and risk – Assessment of safety and risk – Risk Benefit Analysis – Reducing risk – The Three Mile Island and Chernobyl Case Studies

#### **4. Responsibilities and Rights:**

Collegiality and loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination.

#### **5. Global Issues:**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting

Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample code of conduct.

### **Recommended Books:**

1. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996
2. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999
3. Laura Schlesinger, How Could You Do That: The Abdication of Character, Courage, and Conscience, Harper Collins, New York, 1996.
4. Stephen Carter, Integrity, Basic Books, New York 1996.
5. Tom Rusk, The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life, Viking, New York, 1993

### **Drainage Engineering**

**3(2-1)**

#### **Objective:**

- Providing knowledge and skills required on drainage systems, types, requirements and design of drainage systems, operation & maintenance.

#### **Contents:**

##### **Introduction:**

Definition of agricultural drainage, drainage system terms, scope and benefits. Elements of drainage design, types of drainage problems, differences in drainage in humid and arid areas, crop requirements. Surface and Subsurface drainage principles, theories of open drain/ditch and subsurface drainage systems, design criteria.

##### **Drainage Investigations:**

Reconnaissance. Preliminary survey. Design survey. Investigations for surface and subsurface drainage. Auger hole test, Piezometer test. Single well draw down test. Shallow well pump test. Ring permeameter test. Test pit method. Test for determining infiltration rate.

##### **Drainage Requirements:**

Plant processes. Raw materials, Plant structure, Factors controlling production. The soil environment and aeration requirement. Diagnosis and improvement of salt affected soils, Plant response to salinity, Soil

response to excess water and salinity, Situation in which drainage problems exist.

### **Drainage System:**

Investigation procedure, Moisture holding capacity in the root zone, annual irrigation schedule, deep percolation from irrigation, sources causing high water table conditions, determination of barrier zone and drain locations.

### **Surface Drainage:**

Surface drainage system, type and functions of surface drainage ditches, land forming, joint surface and subsurface drainage system.

### **Sub-Surface Drainage:**

Planning subsurface drainage system, Use of vertical drainage system. Design, installation, and construction of subsurface drains, Maintenance of buried drains. Open ditches for drainage. Interceptor and mole drains; Design and construction.

### **Operation And Maintenance Of Drainage System:**

Buried Pipe drainage system, open drainage system, drainage water disposal ponds, drainage observation well, policy and basic requirements, weed control and embankment stability.

### **Practical:**

- ❖ Verification of Darcy's Law by laboratory methods
- ❖ Measurement of seepage losses.
- ❖ Determination of water table,
- ❖ Saturated hydraulic conductivity by piezometers,
- ❖ Auger hole, planning of a subsurface drainage system and outlet with design of a sump;
- ❖ Visit of Drainage Projects.
- ❖ Computation of leaching requirement and drainage coefficient of a drainage basin.
- ❖ Total coliform test in drinking water by multiple fermentation tube method.

## **Recommended Books:**

1. Luthins, J. N. (1978). Drainage Engineering, Robert E. Krieger Publishing Company Huntington, New York.
2. Drainage Manual. (1978). First Edition. A Water Resource Technical Publication U.S. Deptt. of Interior, Bureau of Reclamation, Washington.
3. Ahmad, N. (1993). Drainage of Irrigated Lands of Pakistan, Miraj Din Press, Urdu Bazar, Lahore, Pakistan.

## **GIS & Remote Sensing**

**3(2-1)**

### **Objective:**

- Understanding basic principles of Global Information System (GIS) & Remote Sensing (RS), and their applications in the field of agricultural engineering.

### **Contents:**

#### **Displaying Data:**

Creating map, Adding tabular data to a map, Symbolizing data. Labeling, Charting and Map projection. Layout.

#### **Querying Data:**

Getting attributes of features, Attribute of particular feature, Feature near other, Fall inside polygon, Intersect other feature. Aggregation of data.

#### **Data Creation:**

Creating and editing spatial data. Registration and digitization. Working with images and aerial photographs. Working with CAD in GIS environment.

#### **Analyzing Data For Specific Purposes:**

Creating suitability map for various purposes. Soil, rainfall and water pollution map for various parameters. Use of GRID data for groundwater sources.

#### **Creation Of Surface Model:**

Creating 3D shapes. Advanced visualization. Representing surfaces with TINs. Creation of TINs. Creation of Slope and Aspect theme. Making

contours lines. Analyzing surface runoff patterns. Measuring areas and volumes.

### **Practical:**

Land use/Land cover, water quality monitoring, land degradation, monitoring of environmental pollution, crop production, water resources, weather analysis and forecasting.

### **Recommended Books:**

1. Arc View 3.x, Arc GIS 9.0 and Map Info
2. ERDAS Imagine 8.7 and Differential GPS set.
3. Murai, S. 1997. Remote Sensing Note. Japan Association on Remote Sensing, Tokyo.
4. Foody, G. and Gurrán, P. 1993. Environmental Remote Sensing from Regional to Global Scales. Jhon Willey & Sons, England.
5. Barrett, E.C. and Curtis, L.F. 1992. Introduction to Environmental Remote Sensing. Chapman & Hall, London.
6. Keith, C.C., Bradley O. Parts and Michael P.C.. 2004. Geographic Information Systems and Environmental Modeling.

## **Soil & Water Conservation Engineering**

**3(2-1)**

### **Objective:**

- Understanding the process of soil degradation and its protection affectivity soil moisture and agriculture productivity.

### **Contents:**

#### **Water Erosion:**

Erosion agents. Geologic and accelerated erosion. Damages caused by soil erosion. Water erosion and its types. Factors affecting water erosion. Sedimentation and pollution in relation to water erosion. Water erosion prediction equation. Erosion control practices.

#### **Wind Erosion:**

Factors affecting wind erosion. Types of soil movement. Mechanics of wind erosion. Wind erosion control principles. Wind erosion prediction equation.

**Rainfall and Runoff:**

Rainfall intensity and duration. Infiltration, Factors affecting runoff. Damages caused by floods. Water harvesting.

**Cropping System and Agronomic Measures For Erosion Control:**

Watershed management, Plant cover, Crop rotation, Strip-cropping, Conservation tillage, Contour cultivation, Land capability classification.

**Terracing:**

Field terrace. Classification of terraces. Broad base terraces. Bench terraces. Terrace design. Planning the terrace system. Terrace construction and maintenance.

**Vegetated Outlets:**

Use of vegetated outlets and water courses in the control of erosion. Design of vegetated outlets. Water-way construction and maintenance.

**Conservation Structures:**

Drops Spillways, Chutes and Pipes Spillways; their requirements, components and limitations.

**Water Conservation:**

Definition of drought, Effects of drought. Water stored in soil. Decreasing runoff. Reducing evaporation. Reducing deep percolation. Preventing losses from storage.

**Practical:**

- ❖ Measurements of soil loss from splash erosion by rainfall simulator.
- ❖ Measurements of soil loss using universal soil loss equation.
- ❖ Demonstration of moisture conservation techniques.
- ❖ Field visit to areas with water and wind erosion prevailing.

**Books Recommended:**

1. Suresh, R. 2000. Soil and Water Conservation Engineering. Standard publishers Distributors, 1705-B Nai Sarak, Delhi, India.

2. Schwab, G. O., Fervert, R.K., Edminster, T.W. and Barends. K.K. 1993. Soil and Water Conservation Engineering, John Wiley & Sons, New York.
3. Kirkby, M.J. 1980. Soil Erosion. John Willey & Sons, New York.
4. Linsely, R.K. and Franzini, Joseph. 1996. Water Resources Engineering. McGraw Hill. FAO.
5. Dastane, N. G. 1979. Effective Rainfall. FAO, Irrigation and Drainage Paper 25, Rome, Italy.
6. Hudson, N. 1976. Soil conservation, BT Batsford Ltd. Morga RPC.
7. Schwab G. O., D.D. Fangmeier. W.J. Elloit and R.K. Frevert. 1992. Soil and Water Conservation Engineering. 4th Edition. John Wiley and Sons, New York.
8. Frederick, R.T. and J. A. Hobbs. 1991. Soil and Water Conservation. Prentice Hall, Englewood Cliffs, New Jersey, USA.
9. Schwab G. O., D.D Fangmeier, W. J. Elliot and R. K. Frevert. (1992). Soil and Water Conservation Engineering, 4th edition. John Wiley and Sons, N.Y.
10. Frederick, R.T. and J. A. Hobbs. (1991). Soil and Water Conservation. Prentice hall, Englewood Cliffs, New Jersey (USA)

## **Farm Machinery & Earth Moving Equipment 4(3-1)**

### **Objective:**

- Teaching farm machines required for crop husbandry in addition to land leveling equipment.

### **Content:**

#### **Field Capacities and Cost Analysis:**

Implements Types, Factors affecting field capacity, Cost analysis

#### **Hydraulics Controls and Power Take Off (PTO) Drives:**

Components of a hydraulic system, Types of hydraulic system, Single, Parallel & Series cylinder systems, Limit control, Automatic position and Draft control, Hydrostatic Propulsion drives, PTO drives using two universal joints, Three-joints PTO drives, Loads imposed on P.T.O. shafts, Recommended PTO load limits.

## **Tillage Force Analysis and Hitching:**

Forces acting upon a tillage implement, Mechanics of tillage, Tillage tool design factors, Measuring & evaluating performance, Measuring draft of implements, Vertical and horizontal hitching of trailed implement, Hitches for mounted implements, Depth and draft control on hitches.  
Tillage Implements

### **(A). Primary Tillage Implements:**

Function & Types of Mold board plows, Components of a mold board plow, Reaction of soils to mold boards, Pulverizing action, Turning & inversion, Scouring, Forces acting upon a plow bottom, Effects of soil types, depth of plowing shape & design, attachments & rear furrow wheel and speed on draft & performance. Functions, components & types of Disk plows, Rotary plows, Chisel & subsurface plows.

### **(B). Secondary Tillage Implements:**

Functions, components & types of Harrows, Cultivators. Land rollers and Pulverizers, Subsurface tillage tools & field cultivators.

## **Equipment For Sowing And Planting:**

Functions, components & types of planting equipments, Seed metering devices, Maize drills, Calibration of seed drill. Broadcasting machines, Fertilizer and insecticide placement. Transplanting machines, Spraying systems.

## **Grain and Seed Harvesting:**

Harvesting and threshing methods, Types and development of Combines, functional elements of a combine, Flow path of material, Types and sources of seed loss, Types of threshing cylinders, Threshing effectiveness, Cylinder adjustment, Testing of Combines and its power requirements, Windrowing.

## **Earth Moving Equipment:**

Principles and working of Bulldozers, Soil scrapers and ditchers, Crawler, Parts of Crawler, Comparison of wheel type and Crawler tractors.

## **Practical:**

- ❖ Identification of Primary Tillage Implements.



- ❖ Identification of Secondary Tillage Implements.
- ❖ Determination of Field Capacity of Agricultural Field Implements under actual field condition.
- ❖ Determination of Field Efficiency of Agricultural Field Implements.
- ❖ Determination of tractor Wheel Slip.
- ❖ Calibration of grain drills in Laboratory.
- ❖ Calibration of grain drills in Field.
- ❖ Study and operation of Tractor Hydraulic System.
- ❖ Mini Project.

### **Recommended Books:**

1. Kepner, R. A, R. Bainer and E. L. Barger (1978). Principles of Farm Machinery, AVI Publishing company, Inc. Westport, Connecticut.
2. Smith H. P. and L. H. Wilkes. (1976). Farm Machinery and Equipment, 6th Ed. McGraw-Hill, Inc. USA

## **Agricultural Processing Engineering**

**3(2-1)**

### **Objective:**

- Developing an understanding of equipment and unit processes in agro-industries.

### **Contents:**

Introduction: industrial processes, value addition, structure and composition of food grains and fruits, engineering properties of agricultural materials - physical, mechanical and thermal properties.

Pumps: types of pumps used in the industries, pump selection, pump laws and performance, viscosity effects.

Fans: Classification as to type and design of fans, fan theory, fan performance, factors affecting fan selection, general performance and laws, fans in series and parallel, compression effect.

Material handling and transportation equipment: Belt conveyors, chain conveyors, bucket elevators, pneumatic conveyors, gravity conveyors, augers, and trailer/ trucks

Cleaning, Sorting and grading: Grade factors, washing types and methods of washing, sorting fruits and vegetables, types of sorters, cleaning and sorting, grading, nuts and seeds, types of grain

cleaners/sorters, aerodynamics of small practical, types of separators, machine vision and its applications in grading.

Size reduction: Types of size reduction mills; fineness modulus, value of ground feed, size relationships, energy requirements, size reduction procedures, reducing devices, performance & characteristics of size reduction devices, mixing and types of mixers.

Cold Storages: Need of cold storages, types of cold storages and their design, temperature and humidity controls, heat load, automation of cold storages, air conditioning, aeration.

Drying: Drying and dehydration, moisture content determinations; primary methods, equilibrium moisture content, drying processes, constant rate period, falling rate period, falling rate drying mechanism, dynamics of equilibrium moisture content, effect of temperature upon the rate of drying, effect of air rate upon the rate of drying, heat and mass balance limitation of the drying equipments, calculations, types of driers, psychometric chart.

Packaging Material: Packaging materials and techniques, material properties, packing geometries

### **Practical:**

- ❖ Determination of internal friction and angle of repose
- ❖ Measurement of bulk density of grains
- ❖ Measurement of grain moisture content by oven method and moisture meter.
- ❖ Selection of fans for aeration of bin
- ❖ Calculation of Fineness modulus of wheat flour
- ❖ Demonstration of sieves used for cleaning/grading
- ❖ Carrying out screen analysis of a milling/grinding equipment
- ❖ Study of Psychometric chart to calculate heat transfer during aeration/drying.
- ❖ Study of dehydration characteristics of fruits/vegetable by moisture content vs time curve and drying rate vs moisture content curve.
- ❖ Visit to cold storage facilities.
- ❖ Study tour to visit agricultural processing units and plants.

### **Books Recommended:**

1. Pandey, H. H. K. Sharma, R. C. Chauhan, B. C. Sarkar and M. B. Bera. 2004. Experiments in food process engineering. CBS Publishers and distributors, New Delhi, India
2. Sahay, K. M. and K. K. Singh. 2002. Unit operation of agricultural processing. 2nd ed. Vikas Publishing House, New Delhi, India.

3. Henderson, S.M. 1986. Agricultural Process Engineering. The AVI Publishing Company, Inc. Westport, Connecticut. USA.
4. Hanlon, J. F. 1992. Handbook of packaging engineering. 2nd ed. John Willey and Sons, N.Y., USA
5. Myler, H. R. 1999. Fundamentals of machine vision. Prentice Hall of India, New Delhi.

## **SEMESTER – 7**

**Engineering Elective I** **03**

**Engineering Elective II** **03**

**Engineering Elective III** **03**

**Industrial Chemistry** **03**

Impurities in natural water, hardwater, water softening, boiler scales and deposits, industrial, irrigation and municipal water, metallic corrosion and its inhibition, paints and varnishes, fats and oils, extraction, refining and hydro- generation of oils, sugar industry and its by-products, nitrogenous, phosphatic and potassic fertilizers. Aerobic & non aerobic fermentation.

### **Practical:**

- ❖ Determination of carbonates and bicarbonates in industrial water
- ❖ Determination of chlorides and sulphates in industrial water
- ❖ Determination of pH and TSS in water
- ❖ Estimation of nitrogen, phosphorus and potassium in fertilizers
- ❖ Analysis of an oil for acid, saponification and iodine value.

### **Books Recommended:**

1. Agarwal, O.P., A Agarwal, 2001. Engineering Chemistry. Khana Publishers, India.
2. Kent, A.J. 1997. Riegel's Hand Book of Industrial Chemistry. CBS Publisher New Delhi, India.
3. Shreve, R.H.1987.The Chemical Process Industries. McGraw Hill Book Co., New York

**Project –I** **03**

Introduction to technical report writing, important components of technical writing, selection/preparation of research topic, objectives, review of literature, methodology, data processing, results, conclusions,

summery, abstract, presentation of (data collected in the field/laboratory) results in the form of graphs, tables, figures, and photographs, references and appendices, report writing, presentation methods and skills.

### **Books Recommended:**

1. Awan, J. A. 2004. Technical writing. University of Agriculture press, Faisalabad.

## **SEMESTER – 8**

<b>Engineering Elective IV</b>	<b>03</b>
<b>Engineering Elective V</b>	<b>03</b>
<b>Engineering Elective V1</b>	<b>03</b>
<b>Engineering Economics &amp; Management</b>	<b>03</b>

### **Management Fundamentals:**

Management, Administration, Leadership, Relationship Vs Task Management, Project and Program, Project Life Cycle, Trade Off. Line/Project Organization, Functional Organization, Matrix and Mixed Organization. Role and Responsibilities, Career Path, Special Demands on the Project Manager, Common Characteristics of a most effective Team, Selection of a Project Manager.

### **Project Scheduling And Control:**

Network Techniques, PERT, CPM & GRANT Charts, Use of Project management Softwares, Crashing of a Project, Physical Assets Control, Human Resource Control, Financial Control.

### **Marketing Management:**

Selling versus Marketing, Role of a company: Leader, Follower, Challenger, Basics of Marketing, Place, Price and Promotion. Role of a company in Market Place.

### **ISO 9000 and Quality Management:**

ISO 9000: International Quality Management, Quality Management in Pakistan, Fundamental Quality Concepts, Quality Terminology, Importance and Benefits of ISO-9000, Common Misunderstanding about ISO-9000, Classification of ISO-9000 Series, Brief Description of 20 Elements of ISO-9000, the Auditing Process.

### **Economics and Accounting:**

Budgeting Methods, Cost Estimation, Assets, Liabilities, Capital and Revenue Expenditure, Depreciation, Depletion, Amortization, Owner's Equity Debentures, Loan Financing, Accounting, Qaurds, Ledgers, Profit and loss statement.

### **Recommended Books:**

1. Meredith, J. R. and S. J. Mantel. (2000) Project Management, McGraw Hill Pub. Company.
2. Hand Outs on Engineering Economy and ISO 9000.

**Project –II**

**03**

## **ENGINEERING ELECTIVE COURSES**

### **ELECTIVE COURSES IRRIGATION**

#### **Hydraulic Machinery 03:**

Introduction: Definition, types and uses of hydraulic machinery.

Steady incompressible flow in pressure conduits: Laminar and turbulent flow in circular pipes, major and minor energy losses in pipes, branching pipes, pipes in series, pipes in parallel and pipe network analysis.

Similitude and dimensional analysis: Geometric, kinematic, and dynamic similarity, dimensionless numbers like Reynolds number, Froude number etc., and their application, application of similitude and dimensional analysis in hydraulic model studies.

Similarity laws and factors for turbo-machines: Efficiency, similarities, restriction on use of similarity laws, peripheral-velocity factor, specific speed.

Hydraulic turbines: Definition, types of turbines, suitability of turbines, components of turbines, inlet and outlet velocity diagrams, guide

blade angle, inlet and outlet vane angles WHP and BHP of turbine, hydraulic, mechanical and overall efficiency of turbines, factors influencing the performance of turbines.

### **Practical:**

- ❖ Impact of jet on stationary flat and curved vanes.
- ❖ Measurement of various losses through pipes and pipe fittings.
- ❖ Verification of Reynolds number.
- ❖ Components and operational characteristics of various pumps.

### **Books Recommended:**

1. Clot Industries 1979. Hydraulic Handbook, 3601 Fairbank Avenue, Kanasa City, Kansas 661100, USA.
2. Franzini, J.B. and Finnemore, E.J. 2003. Fluid Mechanics with Engineering Application. McGraw Hill Book Co., Singapore.
3. Jain, A.K. 1990. Fluid Mechanics: A Text Book for Engineering Students.
4. Khana Publishers, New Delhi, India.
1. Streeter, V.L. 1988. Fluid Mechanics. McGraw Hill Inc., New York.
5. Franzini, J.B. and Finnemore, E.J. 2003. Fluid Mechanics with Engineering Applications. McGraw Hill Book Co. Singapore.

## **Soil Dynamics**

**03**

Retaining Walls: Definition, purpose and classification, forces acting on earth retaining structures. Lateral earth pressure. Coulomb's earth pressure theory, assumptions, deficiencies in Coulomb's earth pressure theory. Methods of force projection, active earth pressure, derivation of active earth pressure, passive earth pressure, derivation of passive earth pressure, stress distribution diagram. Surcharge, various kinds of surcharge.

Earth Pressure: Kinds of lateral earth pressure, Rankine earth pressure theory, stability of slopes, stability analysis infinite and finite slope.

Bearing Capacity of Soil: Definition of bearing capacity. Factors affecting bearing capacity, classification of foundations. Stability requirements of a foundation, methods of determining bearing capacity, load and settlement, soil loading test.

### **Practical:**

- ❖ Determination of consolidation under given load.
- ❖ Determination of shear strength of soil.
- ❖ Coulomb's earth pressure theory.
- ❖ Methods of force projection.

### **Books Recommended:**

1. Jumikis, A.R. 1994. Soil Mechanics, D. Van Nostrand Company Inc., Princeton, New Jersey.
2. Terzaghi, K. 1997. Soil Mechanics in Engineering Practice. John Wiley & Sons, New York.
3. Mckeyes, E. 1989. Agricultural Engineering Soil Mechanics. Elsevier New York.
4. Smith, G.N. 1990. Elements of Soil Mechanics. BSP Professional Books, Oxford.

## **Pumps and Tube wells**

**03**

Introduction: Functions of pumps and tubewells, importance of pumps and tubewells in irrigation and drainage, groundwater exploitation by tubewells. Description of Tubewells: Components of a tubewell, factors affecting selection

of site, well drilling methods; cable tool method, direct rotary method, inverse rotary method and their respective merits and demerits, well design; depth of well, well casing, well screen, filter pack. Well development methods, typical drilling problems, well losses, well efficiency, well logs, gravel packing and well maintenance. Skimming wells.

Pumps: Pump components, pump classification; centrifugal, jet, positive displacement, turbine pumps, submersible pumps, propeller and mixed flow pumps and air lift pumps- Types of impellers. Terminology in pumping systems- specific speed, priming, pumping energy, total dynamic head, pump problems and their remedies. Power requirement of pump.

Characteristic pump: TDH-Q, BP-Q, NPSH-Q and Efficiency-Q curves. Cavitation, Net positive suction head (NPSH), affinity laws, pump testing, maintenance of pumps.

Irrigation System Head and Power Requirements: Suction lift, well draw down, friction head loss, operating head-seasonal-variation in system head curve, pump selection, prime mover electric, diesel and their selection, feasibility of prime mover selection.

**Practical:**

- ❖ Study of components and operational characteristics of various pumps.
- ❖ Use of characteristic curves of different pumps.
- ❖ Design of a pumping well using field data.
- ❖ Design of gravel packing for specific conditions.
- ❖ Determination of pump efficiency
- ❖ Study of various components of tubewell
- ❖ Discharge measurement of a tubewell

**Books Recommended:**

1. Ahmad, N. 1995. Tubewell Theory and Practices, Shahzad Nazir Publisher, Gulberg-III, Lahore.
2. Colt Industries 1979. Hydraulic Handbook, 3601 Fairbank Avenue, Kanasa City, Kansas 661100, USA.
3. Driscoll, F.G. 1987. Groundwater and Wells, Johnson Division, St. Paul, Minnesota, 55112, USA.

**Water Management Engineering****03****Water Course Design And Improvement:**

Introduction, Planning for watercourse improvement. Design criteria. Hydraulics of watercourse design, Different cross sections of watercourse, Water course design. Materials and procedures, Moghas, Construction of unlined and lined watercourses, OFWM structures (conveyance, control).

**Precision Land Leveling:**

Precision land leveling, Objective, Advantages and disadvantages of land leveling, Farm assessment and layout, Traditional survey layout procedure. Adjustment of borrow and fill, procedure for sloping fields, Land leveling maintenance.

**Water Storage Tanks:**

Sizing a water storage tanks, Considerations in sizing water storage tanks, General criteria, Design of storage tanks, construction of water storage tank, Preparatory works, Materials and procedures, Concrete base, Brick or stone walls, Concrete walls, Back filling. Stone pitching, Quantities.



## **Water Harvesting:**

Introduction, Goals and objectives, Site selection, Area appraisals, Topographical surveys, Land use plan and work plan, Land development and conservation structures, Leveling, terracing, improved bunds, improved tillage, field spillways, water ways, diversion ditches, Storage structures, Water balance, Site investigation, Water retention dams/ponds.

## **Agronomy Practices For Water Management:**

Development of Crops and Cropping Systems, Principles of Crop Management, Management of land and Soil, Seed and Sowing, Fertilizers and Nutrients, Crop protection, Harvest and Post-harvest Technology Centers, Objectives, Selection, and conduction of Farm Demonstration Centers, Extension Methods.

## **Conjunctive Use Of Water:**

Conjunctive use of saline groundwater. Effects of sediment and salinity on conjunctive use of water.

## **Recommended Books:**

1. On Farm Water Management Field Manuals, (Revised 1996-97)
  - a. Vol. IV Watercourse Design and Improvement.
  - b. Vol.V Land Development Precision Land Leveling and level Border Design.
  - c. Vol.VI Irrigation Agronomy.
  - d. Vol.VII Water Storage Tanks.
  - e. Vol. X Water Harvesting and Spate Irrigation  
Ministry of Food, Agriculture and Livestock (Federal Water Management cell) Government of Pakistan, Islamabad.
2. Hoffman, G. J, T.A. Howell and K.H. Solomon, (1992).  
Management of Farm Irrigation Systems. ASAE.

## **Ground Water Hydrology**

**03**

### **Introduction:**

Basic concepts of Ground Water and Soil water, Types of subsurface water, Water Potential, Aquifer types, Soil water movement and Ground water movement, Forms and origins of Ground water, Aquifer functions, Porosity, Storage coefficient, Hydraulic conductivity, transmissivity.

### **Ground Water Movement:**

Darcy's Law and its applications, Observation wells, Piezometers, Flow nets, Streamlines, Equipotential lines, Steady and non-steady flow.

### **Contamination In Ground Water:**

(The teacher will elaborate this topic to the students)

### **Well Hydraulics:**

Steady flow in confined and un-confined aquifers, Steady flow in confined with uniform recharge, Unsteady flow in un-confined aquifer, Wells near aquifer boundaries, Multiple well system, Specific capacity, Well losses, Well efficiency and aquifer testing.

### **Construction Of Tube Wells:**

Well drilling methods, selecting and setting of screens, design and placing of gravel pack, methods of well development, Tube well performance tests.

### **Recommended Books:**

1. Johnson, 1988. "Ground Water & Wells" Johnson and Co. USA
2. Ranghunath, H.M. 1987. "Ground Water" Willy Eastern Ltd. Singapur
3. Bouwer, H. 1996. "Ground water Hydrology" Mc Graw Hill Inc. New York
4. Ahmad, N. 1985. "Ground water Resources of Pakistan" Shahzad Nazir Publisher, Gulberg-III, Lahore

## **Farm Irrigation Systems**

**03**

### **Farm Irrigation Systems And Systems Design Fundamentals :**

Functions of farm irrigation systems, Types of farm irrigation systems such as diversion methods, conveyance methods, and application methods, Design of farm irrigation systems, Data for design, Water source evaluation and determination of daily design requirements.

## **Crop Water Requirements:**

Plant soil relationship, Evapotranspiration, Determination of evapotranspiration and irrigation scheduling.

## **Surface Irrigation:**

Different methods of surface irrigation, furrow irrigation, border irrigation and basin irrigation, Surface irrigation process, Effectiveness of surface irrigation i.e. uniformity, application efficiency etc. Design of surface irrigation system, Infiltration data for surface irrigation, Design of furrow, border and basin irrigation systems.

## **Sprinkle Irrigation System:**

Advantages and disadvantages of the system, Types of sprinkle system, Components of sprinkle system, Design of set-move including its layout, number of lateral operated per irrigation set and sprinkle selection.

## **Trickle Irrigation:**

Advantages and disadvantages of trickle irrigation, Problems associated with trickle irrigation, Trickle irrigation methods, Trickle irrigation system components, Trickle irrigation laterals, Mainlines and manifolds, Control heads and control of trickle irrigation clogging.

## **Recommended Books:**

1. James, L. G. (1988). Principles of Farm Irrigation System Design. John Wiley and Sons, New York.

## **Reference Books:**

1. Walker, W. R. and G. V. Skoegerboe, (1987). Surface Irrigation Theory and Practices. Prentice-Hall Inc., Englewood Cliffs, New Jersey, USA.
2. Ahmad, N. (1987) Irrigated Agriculture. MirajDin Press, Urdu Bazar, Lahore, Pakistan.
3. Crop Water requirement by F.A.O

## **Type: Lab**

- ❖ Design and layout of surface irrigation methods for a given field.

- ❖ Field evaluation of surface irrigation system.
  - ❖ Design and evaluation of sprinkler irrigation system for a given field.
  - ❖ Design and evaluation of drip irrigation system
  - ❖ Evaluation of surface irrigation system using appropriate computer
  - ❖ Software (BASCAD etc.)
1. Preparing irrigation schedule of cropped field.

## **Soil and Water Conservation Engineering 3(2-1)**

Introduction: Land and water resources of Pakistan, soil and water conservation problems and its importance, soil and water conservation practices in Pakistan. Water Conservation: Definition of drought, effects of drought. Water stored in soil. Decreasing runoff. Reducing evaporation. Reducing deep percolation.

Preventing losses from storage. Rainfall and Runoff Relationship: Factors affecting runoff, rainfall characteristics related to erosion. Analysis of precipitation data and effective precipitation. Water Erosion and Control Practices: Factors affecting erosion by water, types of water erosion, mechanics of erosion, forms of water erosion, universal soil loss equation and its components, soil loss estimation and erosion control practices. Wind Erosion and Control Practices: The mechanics of detachment, transport and deposition of soil particles, estimation of soil loss by wind erosion and control practices. Conservation Techniques: Terracing; Functions, classifications, design, location and maintenance. Contour farming; Water Harvesting; Principles and techniques, short and long term methods.

Vegetated Waterways: Use, design and maintenance of vegetated waterways. Conservation Structures: Functional requirements of structures, limitations and design of drop spillways, culverts and pipe spillways. Watershed: Definition, watershed characteristics, importance of watershed management in water resources. Embankments and Farm Ponds: Types, foundation requirements and design of earth embankments, mechanical spillways, flood or emergency spillways, types, requirements, site selection and design of farm ponds.

### **Practical:**

- ❖ Measurements of soil loss from splash erosion by rainfall simulator.
- ❖ Measurements of soil loss using universal soil loss equation.
- ❖ Demonstration of moisture conservation techniques.

- ❖ Field visit to areas with water and wind erosion prevailing.

### **Books Recommended:**

1. Suresh, R. 2000. Soil and Water Conservation Engineering. Standard publishers Distributors, 1705-B Nai Sarak, Delhi, India.
2. Schwab, G. O., Fervert, R.K., Edminster, T.W. and Barends. K.K. 1993. Soil and Water Conservation Engineering, John Wiley & Sons, New York.
3. Kirkby, M.J. 1980. Soil Erosion. John Willey & Sons, New York.
4. Linsely, R.K. and Franzini, Joseph. 1996. Water Resources Engineering. McGraw Hill. FAO.
5. Dastane, N. G. 1979. Effective Rainfall. FAO, Irrigation and Drainage Paper 25, Rome, Italy.
6. Hudson, N. 1976. Soil conservation, BT Batsford Ltd. Morga RPC.
7. Schwab G. O., D.D. Fangmeier. W.J. Elloit and R.K. Frevert. 1992. Soil and Water Conservation Engineering. 4th Edition. John Wiley and Sons, New York.
8. Frederick, R.T. and J. A. Hobbs. 1991. Soil and Water Conservation. Prentice Hall, Englewood Cliffs, New Jersey, USA.

### **Project Planning and Management**

**3(3-0)**

Project Planning, Scheduling and Controlling by Deterministic Models: project planning activities, Rectangular bar chart, CPM, developing a critical path schedule, determining the minimum total cost of a project, Manual versus computer analysis of critical path methods, preparing a execution schedule, scheduling resources, delivering Materials, scheduling laborers, Financing the project, Job layout, Project control during construction, keeping equipment records, Project supervision. construction cost control, cost control records. Project Planning, Scheduling and Controlling by Probabilistic Models: PERT project Evaluation & Review Technique, Statistical tools as mean variance. Standard Deviation. Probability distribution, beta courses, center limit, Use of computer software in project management and planning. claims and arbitration: claims, escalation, indexation, arbitration and litigation. Factors Affecting the Selection of Equipment and Tools: standard types of equipment, special equipment, the cost of owning and operating equipment, depreciation cost, straight line depreciation, decline balance method, sum of the year, digit method, Investment costs, operating costs, economical life of construction equipment, cost of depreciation and replacement, Maintenance and repair costs, down time costs, economical cost of equipment, sources of construction equipment.

.labour problems, labour organization, prevention and settlement of disputes.

### **Practical**

- ❖ Preparing a PC-I project proposal for a small irrigation project

### **Books Recommended:**

1. Guidelines of the Planning Commission on Project Planning Execution and monitoring.

## **Irrigation Water Management Techniques 3(2-1)**

Introduction: Concept of water management and its developments in Pakistan, components of water management. Water distribution: Irrigation system management, warabandi-types, rotation system advantages and disadvantages, constraints of warabandi.

Soil-water plant Relationship: Soil moisture and its types, soil moisture characteristics, field capacity, wilting point, total available water, management allowed deficit, infiltration rate, hydraulic conductivity.

Efficiencies: Definition, conveyance, application and storage efficiencies, irrigation efficiency, irrigation system efficiency. Land Leveling: Importance of land leveling in water management, topographic survey, system layout, determining cuts and fills, land leveling equipment, laser land leveling and use of total station. Discharge Measurement: Units of measurement, equipment and methods of measurement, interpretation of discharge data, water losses. Watercourse Design and Maintenance: Hydraulics of open channel flow, flow profiles, design of watercourse for a command, watercourse structures, cleaning and maintenance of watercourses. Watercourse Construction: Construction requirements and procedure, materials for construction, construction machinery, cost of watercourse lining and improvement. Lining of Watercourse: Materials of lining, lining techniques, cost estimate of lining

### **Practical:**

- ❖ Determination of field capacity and wilting points of a soil sample.
- ❖ Land leveling of a given field and cost estimate.

- ❖ Field visits of earthen and lined water courses.
- ❖ Flow measurement in a watercourse and interpretation of data.

### **Books Recommended:**

1. Allen, R.G., Pereira, L.S., Raes, D. and Smith, M. 1998. Crop Evapotranspiration (Guidelines for computing crop water requirements), FAO 56, Rome, Italy.
2. OFWM. 1991. OFWM Field Manual 1-4, Federal Water Management Cell. Ministry of Food, Agriculture and Livestock, Islamabad, Pakistan.
3. Jensen, M.E, 1981, Design and Operation of Farm Irrigation System. ASAE, Monograph, USA

### **Drainage of Irrigated Lands**

**3(2-1)**

Drainage Problems: Drainage systems in Pakistan and their extent. Current drainage practices; benefits of drainage; occurrence of water in the soil, source of excess water, pressures in the soil water, water table, ground water flow (Darcy's Law), saturated flow theory, flow through stratified soils, hydraulic conductivity and its measurement, drainable pore volume, salinity and water movement; leaching requirements; drainage requirements. Salt affected soils, their classification. Diagnoses and improvement of soil affected soils. Planning and design of drainage system. Field investigation, stages of project planning, design of pipe drainage system.

Surface Drainage: Design of open ditches; methods of construction; different ditch systems; maintenance of open drains. Interceptor drains and their design.

Sub-Surface drainage: Tile drains, mole drains; depth and spacing. Design criteria (steady and non steady state); drainage coefficient; length and size of the tile drains. Outlets for tile drains. Size and length of perforated pipes (pvc) for subsurface drains.

Vertical Drainage: Design and material. sump and pumps, experience of vertical drainage in Pakistan.

### **Practical:**

- ❖ Verification of Darcy's Law by laboratory methods, Measurement of seepage losses.

- ❖ Determination of water table, Saturated hydraulic conductivity by piezometers, Auger hole, planning of a subsurface drainage system and outlet with design of a sump; Visit of Drainage Projects.
- ❖ Computation of leaching requirement and drainage coefficient of a drainage basin.

### **Books Recommended:**

1. Siddiqui, I. H. 2003. Irrigation and Drainage Engineering. Royal Book Company, BG-Rex Centre Fatima Jinnah Road, Karachi.
2. ILRI (1979-80) Drainage Principles and Applications. Publication 16, Vol.I-IV, Netherlands.
3. Smedema, L.K. and F.W., Rycroft. 1983. Land Drainage: Planning and Design of Agricultural Drainage Systems, Batsford (BJ) Ltd., Fitzhardinag Street, London
4. Luthin, M. 1974. Drainage Engineering. John Willy and Sons.

## **Land Reclamation**

**3(2-1)**

Salt Affected Soils: types, extent and causes, origin of salt in soils, origin and nature of saline and sodic, alkali and waterlogged soils, exchangeable bases and cation exchange in soil, soil reaction, solute movement of water in soil, pH value of soil and its significance. Soil Reclamation: reclamation techniques, saline soils leaching requirements, amendments for sodic soils, gypsum requirements. Management of Salt Affected Soils: provision of surface, subsurface or vertical drainage, salt tolerance crops, agronomic practices, manures, irrigation practices. Management of Waterlogged Soils: causes, extent and remedial measures, effect of waterlogging on plant growth, management of waterlogged soils, irrigation water quality effects on soil environment.

### **Practical:**

Measurement of infiltration rate of saline, sodic and waterlogged soils, movement of solutes, preparation of soil paste and soil saturation extract, chemical analysis for pH, EC, SAR, ESP, and cations and anions, quality of irrigation water, water table depth measurements.

### **Books Recommended:**

1. Abrol, I., J.S.S.P Yadav and F.I. Masood, 1988. Salt affected soils and their management. Soil Bull. 390. FAO. Rome Italy.
2. Bresler, E., B.L. McNeal and D.L. Carter. 1982. Saline and Sodic Soils, Principles, Dynamics, Modeling. Springer, Verlag, New York.



3. Tanji, K.K. 1990. Agricultural salinity assessment and management. ASCE No.71, New York, USA.
4. Gupta, I.C. 1990. Use of saline water in Agriculture. Oxford and IBH Pub. Co., New Delhi, India.

### **Quantity Survey and Cost Estimation**

**3(2-1)**

Scope: Scope of civil engineering works; General practice in government departments for schedule of rates and specifications; Rate analysis; Specifications for various items of construction.

Bill of Quantities (B.O.Q) & Measurement Book (M.B): Types and methods of estimates, Working out quantities, rates and cost analysis of construction materials; Valuation, depreciation and sinking fund.

Contents and preparation of bills of quantities for different projects like irrigation, roads, sanitary, building etc. and maintaining of Measurement Books. Measurement, specification and costing of excavation and back filling, mass concrete retaining walls, beams, concrete piles, steel or wooden truss or steel framed gantry, estate road, sewer and water main pipe works, Priced bill of quantity.

Tendering: Preparation of civil engineering contracts and tender documents. Introduction to claims and conflicts resolution e.g. escalation, indexation, arbitration and litigation. Evaluation of proposals and contracts.

#### **Books Recommended:**

1. E.W. Steel and Terence J. Mc GHEE, Estimating & Costing,
2. S. Dutta, Estimating and Costing in Civil Engineering, 22<sup>nd</sup>PP ed. S. Dutta & Co. Lakhnow
3. D.D.Kohli, Estimating, Costing and Accounts, 9<sup>th</sup>PP ed. S.Chand & Co. Pvt. Ltd.
4. Keith Collier, Fundamentals of construction. Estimating & Cost Accounting, Mc Graw Hill Book Co.

## **ENGINEERING ELECTIVES FARM MACHINERY**

### **Design of Agricultural Machinery**

**3(2-1)**

#### **Philosophy Of Design:**

Formulating of procedure, importance of machine design in Agricultural Machinery, Reliability, Engineering Standards, User economics.

### **Tolerance Design And Statistics:**

Tolerance and allowances, application of statistics to manufacturing.

### **Stresses:**

Stress failure theory, Designing for deflection, Strain determinations, Stresses caused by impact.

### **Power Transmissions:**

V-Belt forces, kinematics and design procedure, Chain drive, Forces, selection and design procedure. Universal Joints, description and functioning in Agricultural Machinery.

### **Linkages In Farm Machinery:**

Velocity and acceleration determination, Four bar mechanism, Machinery mechanism, Forces on plows and discs.

### **Hydraulic Power System:**

Hydrostatic drives and hydraulic pumps, Pump performance and rating, Hydraulic motors performance and rating, Control valves, Hoses and fitting, Cylinders.

### **Design Of Surfaces Of Plow Bottoms:**

Design of moldboard plow and disk plow.

### **Stability Of Plows:**

Force equilibrium and stability, Supporting elements, Plow stability in horizontal plane, Procedure for measuring the quality and testing plows.

### **Practical:**

- ❖ Chain and belt drives design and installation.
- ❖ Determine the angular relation between the input and output of universal joints.
- ❖ Analysis of thresher.
- ❖ Calculate the forces in three-point hitch of tractor.
- ❖ Visit to Farm Machinery Institute for Implement evaluation.

- ❖ Assembling and disassembly of seed planter, sprayer and engine.
- ❖ Analysis and construction of agricultural machines.
- ❖ Design methods of a mould board plow.
- ❖ Design methods of chisel plow.
- ❖ Design methods of disc plow.
- ❖ To Study the Different Hydraulic Systems using Hydraulic Circuit Trainer.

### **Recommended Books:**

1. Krutz, G., L. Thompson and P. Claar. (1984). Design of Agricultural Machinery. John Wiley and Sons Inc. USA.
2. Bernacki, H. J. Haman, C. Kanafojski, Agricultural Machines, Theory and Construction, Vol. I , U.S. Department of Commerce.
3. Shigley, J.E. and C. R. Mischhe, (2000). Mechanical Engineering Design. Fifth Edition. McGraw Hill Publications Inc. USA.

## **Boiler Engineering and Power Plants**

**3(2-1)**

Boiler Engineering: Introduction, types, construction, mounting, accessories steam cycle, steam nozzles, supersaturated expansion in nozzles, heat drop in saturated and supersaturated expansion, steam injector, steam turbine, work done, velocity diagram, work done in blading, velocity compounding, pressure compounding, impulse turbine, heat account for boiler and turbine, amount of fuel burnt, acceptance tests, analysis and calorific value of fuel, analysis of flue gases, amount of steam produced, pressure and quality of steam, design of boiler and pressure control system devices. Properties of steam, enthalpy of water, dryness fraction, enthalpy of wet steam, use of steam tables, super heated steam, internal energy of steam.

Power Plants: Steam Plants: Introduction, general layout of modern steam plants, steam generators, engines and auxiliary components, back pressure and pass out turbines, deviation of actual cycle from ideal, turbine pump and condenser.

Gas Turbine and Power Plants: Introduction, the gas turbine cycle, modification in basic cycle, isentropic efficiency of compressors and turbines, intercooling and reheating, explosion type gas turbine with solar heating, development and improvement in gas turbine. Jet propulsion plant, comparison of steam and gas power plants.

### **Practical:**

- ❖ Demonstration and inspection of different types of boilers.

- ❖ Determination of calorific value of fuel
- ❖ Analysis of flue gases using gas analyzer
- ❖ Quality analysis of steam
- ❖ Measurement of impulse force on vane of turbine
- ❖ Assessment of power generation at output shaft
- ❖ Visit to different power plants
- ❖ Visit to sugar and textile industries to study boilers and steam power.
- ❖ Visit to nuclear and steam power plants.

### **Books Recommended:**

1. Chattopadhyay, P. 2000. Boiler Operation Engineering. TATA McGraw Hill Pub. Co. Ltd., New Dehli, India.
2. Kearton, W. J. 1999. Steam turbine theory and practice. 7th ed. CB Spublishers & Distributors. New Delhi, India..
3. Granet, I. and M. Bluestein. 2001. Thermodynamics and heat power, Pearson Education Asia.
4. Cengel, Y. A. R. H. Turner. 2005. Fundamentals of thermal fluid sciences. McGraw Hill International.

### **Energy Resources and Management**

**3(2-1)**

Introduction: Overview of various types of energy sources (renewable and Non-renewable) and its use in the country. Energy management/audit with reference to: fertilizer (organic/inorganic), chemical controls, irrigation, mechanization, post harvest system and food consumption. Technological alternative for efficient energy management in agriculture.

Energy reclamation from agricultural crops/wastes: Energy from biomass production. Biogas, various types of biogas plants. Design, installation, operation and management of biogas plants.

Solar Energy: Solar system, solar radiation, basic earth-sun angles, time derived solar angles, estimation of solar radiation, radiation measurements, solar radiation collectors, various uses of solar energy in domestic/agriculture, solar energy conservation

Wind energy: Wind energy potential in the country. Application of wind energy

(domestic / agriculture). Importance of vertical and horizontal axis for wind mills, wind operated pumps for water lifting.

## **Practicals:**

- ❖ Estimation of energy requirements for major crops.
- ❖ Performance/ evaluation of biogas plants
- ❖ Estimation of solar and wind energies
- ❖ Study of different types of solar dryers
- ❖ Performance/evaluation of wind mills.
- ❖ Analysis of engine performance for energy conservation.
- ❖ Measurement of energy contents in diesel, biomass, and vegetable oil with calorimeter.

## **Books Recommended:**

1. Sorensen, B. 2004. Renewable Energy. 2004. Elsevier Academic Press, UK
2. Singh, M. P. 2005. International Encyclopedia of energy. DAYA Publishing House, Dehli, India
3. Board, N. Handbook on biogas and its application. National Institute of Industrial Research, Dehli, India
4. Pimental, D. 1993. Hand Book of Energy Utilization in Agriculture. CRC Press Inc. Florida, USA.
5. Rai. G. D. 2001. Solar energy utilization. Khanna Publishers, N. Dehli, India
6. Stout, B.A., 1990. Hand Book of energy for world agriculture. Elsevier Applied Science Ltd.

## **Farm Machinery Management**

**3(2-1)**

Machine performance: Machines capacities; time efficiency; machine manoeuvrability; field patterns, factors effecting machine performance.

Power performance: Tractor power; draw bar power; PTO power, hydraulic power, power measurement; tractor tests, Nebraska Tractor Tests.

Ergonomics: Introduction, operator skill, operator aids for control, machine sensors, GPS role in machine control, operator safety and environment Machinery Management: Machinery costs – ownership costs, operating costs, and timeliness costs; machinery selection and replacement.

Optimization: optimum use of machine, estimation of power for a machine, part load operation, break even point, linear programming.

Hay and Forage harvesting: Mechanics of cutting plants; mowers; mover conditioners, balers; impact cutting; curing and preservation of forage; wind rowing.

Grain harvesting: Introduction, methods and equipment, reaper and windrowing; types of threshers, threshing cylinders, threshing

losses, combine harvesting: types of cutting heads and tracks for different crops(wheat, rice, maize, sunflower), functional processes – gathering, cutting, pickup, feeding, threshing, separation, cleaning; combine losses and adjustments, performance evaluations.

Special crop machines: Cotton harvester; maize harvester; sugarcane harvester; potato harvester.

Precision Farming: Introduction, precision farming methods, precision equipment- laser land levelling, sensors, variable rate application, role of GIS and GPS in precision farming

### **Practical:**

- ❖ Measurement of Drawbar and PTO power of a tractor.
- ❖ Calculation of field capacity of selected farm machinery.
- ❖ Demonstration of reaper and thresher.
- ❖ Demonstration of combine harvester.
- ❖ Measurement of combine losses.
- ❖ Measurement of maturity level of crop.
- ❖ Thresher and Combine adjustments to solve grain breakage problem.
- ❖ Study of cost analysis of combine harvesting.
- ❖ Demonstration of laser land leveller and its adjustments.
- ❖ Demonstration of GPS for precision farming.

### **Books Recommended:**

1. Hunt, D. 2003. Farm Power and Machinery Management. Iowa State University Press, Ames, Iowa, USA.
2. Kepner, R. A., R. Bainer, and E.L. Barger. 2000 Principles of Farm Machinery, John Wiley and sons, N.Y
3. Suresh, R. and S. Kumar. 2004. Farm power and machinery engineering. Standard Publishers, New Delhi, India
4. Klenin Popov & Sakun, 1995. Agricultural Machines. Kolos Publishers Moscow, U.S. S.R.

### **Post Harvest Engineering**

**3(2-1)**

Introduction: Importance of cereal grains and other food products, food preservation, the food cycle, important factors of food production.

Properties of Cereals: Cereal grains and their structure, physical properties, biochemical properties.

Factors Affecting Grain Stability: Physical factors, biological factors, chemical factors, thermal factors.

Post harvest Losses: Forms and measurement of post harvest losses, measures to control losses.

Pre-storage handling of Food Products: Physiological maturity, harvesting, threshing, collection, transportation, and receiving system.

Drying and Aeration: principle of drying, solar drying, artificial drying, types of dryers, components of dryers, factors affecting drying rate, natural aeration, artificial aeration, methods of aeration, air conditioning/refrigeration.

Storage: Basic requirements for a storage structure, classification of storage structure, types of Public storage structures, storage structure design, temporary and permanent storage facilities, Non-conventional storage facilities, considerations in selecting type of storage structure, problems in grain storage, stored grain pests, control methods.

Grades and Standards: Importance of grades and standards, food quality, establishing grades and standards, assessing the grade, grade factors and their importance, grading equipment, representative sampling, WTO and its regulation regarding quality control.

#### **Practicals:**

- ❖ Measurement of moisture content of grain, fibre, and other food products
- ❖ Measurement of size, shape, density, specific gravity, porosity, angle of repose, coefficient of friction, hardness test.
- ❖ Thermal properties of biological materials; specific heat, thermal conductivity.
- ❖ Study of air conditioning and refrigeration plants.
- ❖ Study of storage structures and their specifications.
- ❖ Visits to public / private storage structures.

#### **Books Recommended:**

1. Sahay, K. M. and K. K. Singh. 2002. Unit operation of agricultural processing. 2nd ed. Vikas Publishing House, New Delhi, India.
2. Pandey, H. H. K. Sharma, R. C. Chauhan, B. C. Sarkar and M. B. Bera. 2004. Experiments in food process engineering. CBS Publishers and distributors, New Delhi, India.
3. Toledo, R.T. 1980. Fundamentals of food processing engineering. AVI Pub. Co., Inc. Westport Connecticut.
4. Mohsenin, N.N. 1980. Thermal properties of food and agricultural materials. Gordon and Breach, N.Y., USA.
5. Mclean, K.A. 1980. Drying and storing combinable crops. Farming Press, Ltd. Wharfedale Road, Ipswich, Suffolk

## **Industrial Engineering and Management**

**3(2-1)**

Introduction: Industrialization and industrial policies of Pakistan; Classification of agro-based industries, management, operations research, system engineering, statistics, ergonomics, manufacturing engineering, ISO & WTO regulations

Production System Design: Mill and Plant Layout; Line Diagrams; Flow Diagrams, Work measurement, General Terminologies used in physical measurements.

Product System control: Inventory control, production control, production

planning, quality control, statistical process control charts, sampling plan, total quality management, Industrial Management: Definition of

Management; Functions of Management: Personal Management; human resource development, Policy Formulation and decision Making.

Materials Purchase and Stores Management. Cost Management.

Production Routing, Scheduling and Dispatch Management Operations

Research: introduction, linear programming, graphical and algebraic method, transportation algorithm, assignment algorithm, queuing theory and simulation.

Engineering Economy: Pricing, costing, interest calculation, present worth, future worth, annual rate of return, annual cost method, return on investment, payback method, cost control engineering.

Industrial Safety Engineering: Safety Measures, Accidents Causes, Job Safety Analysis. Machine Guards and Safety Equipment; Control of Noise, Contaminants and Radiation/heat etc. Health hazards and Safety Management. Health and Safety Policies.

Industrial Environmental Communication and Pollution: Industrial Environmental Education; Factors Affecting Environment of different industries; Environmental Planning, Monitoring and Control Strategies of Recycling Materials for Ecological balance. What is Pollution; Sources of Pollution, e.g. Natural Sources, Industrial Sources, Point Sources and Non-Point Sources. Industrial Revolution and its Impact on Soil, Water, Air and human health. Effect of Unplanned Technological growth on Environmental Pollution.

### **Practicals:**

- ❖ Study of organizational structures of selected industries.
- ❖ Study of plant/factory layout principles.
- ❖ Estimation of air, water, and soil pollutants of selected industries.
- ❖ Study of different types of cleaners and conveyors.
- ❖ Evaluation of different storage techniques.
- ❖ Visit to local vendor Industries.
- ❖ Student projects



### **Books Recommended:**

1. Ahuja, K.K. 1994. Factory organization and principles of management, Khanna Publishers, Delhi.
2. Hicks. P. 1994. Industrial engineering and management. 2<sup>nd</sup> ed. McGraw Hill International Edition. N. Y.
3. Kumar, B. 2001. Industrial Engineering, Khanna Publishers, Nath Market, Delhi, India.
4. Dalela, D. S. and Ali. D. Mansoor. 1992. A Text Book of Industrial Engineerin and Management System. Standard Publishers and Distributors, Delhi.
5. Telsang, M. 2004. Industrial engineering and production management. Tata Mcgraw Hill. N. Delhi, In

### **Reverse Engineering in Agricultural Engineering 3(2-1)**

#### **Objective:**

- Optimization of mechanical inputs
- Providing ingenious and indigenization solutions to problems
- Economization / cost reduction

#### **Content:**

#### **Overview:**

Definition and scope

#### **Steps Involved In Various Stages Of Reverse Engineering;**

Analysis of functionality of the design: a) List of functional attributes of the machine/part. b) Attributes to be added/Modified by re-engineering;

#### **Exploding/Disassembling The Sub-Assembly And Making The BOM (Bill of Materials):**

Materials Scanning for each Component: Physical Properties, Hardness and Tensile testing, Chemical testing- Materials Spectrometry, Functional validation of materials selection and performance, Recommended Improvement and/or modification in Materials etc;

## **Metrological Probing In Reverse Engineering:**

Scanning of the parts, 3-D drawings with various design softwares.

## **Creating The Computer Aided Dimensional Parameter:**

Creating The Manufacturing processes by closely analyzing the manufacturing requirements of each part;

## **Practical:**

- ❖ Drafting the Modified Parts: Create 2D drafts or 3D models of the parts in the BOM. (Depending on the Criticality or the Manufacturability of the parts) in BOM. (use Solid-works).
- ❖ Create the complete Drawing folder for the BOM
- ❖ Create assembly model in Solidworks. Perform actual Assembly.
- ❖ Create Request for quote (RFQ) package for local vendors
- ❖ Test of Modified Functional Paramters.

## **Recommended Books:**

1. Krutz, G., L. Thompson and P. Claar. (1984). Design of Agricultural Machinery. John Wiley and Sons Inc. USA.
2. Bernacki, H. J. Haman, C. Kanafojski, Agricultural Machines, Theory and Construction, Vol. I , U.S. Department of Commerce.
3. Shigley, J.E. and C. R. Mischhe, (2000). Mechanical Engineering Design. Fifth Edition. McGraw Hill Publications Inc. USA.
4. Donald H. Nelson and George Schneider, JR. 2001, Applied manufacturing process planning. Prentice- Hall, Inc., Upper Saddle River, New Jersey 07458 USA.

## **Engineering Electives: Environmental Engineering**

### **Water Quality Management**

**03**

Introduction: Definition and concepts, irrigation and drainage water quality, water quality terminology, water quality objectives, quality criteria and standards for irrigation water carcinogenic/non carcinogenic substances, water quality status in Pakistan.

Water treatment, Water pollution and their sources, water treatment techniques i.e. coagulation, softening, mixing and flocculation, sedimentation, filtration etc.

Drainage Effluents and Management Techniques: Sources of drainage water, characteristics, quality of drainage water, alternatives for disposal of drainage water, drainage water reuse techniques, crop management, soil management techniques, chemical management techniques, drainage and leaching fractions, concepts of preferential flow.

Agricultural chemicals and Groundwater Contamination: Agricultural chemical, their uses, trends and properties, concept of nitrate, nitrogen and pesticides transport through the soils, behavior of agricultural chemicals in flooded/water logged soils, management practices to avoid groundwater contamination.

### **Practical:**

- ❖ Analysis of drainage water for irrigation purposes.
- ❖ Waste water analysis for BOD, COD and other chemicals.
- ❖ Visit to waste water treatment plants, drainage system and drainage reuse sites
- ❖ Use of computer software to assess non-point source pollution.

### **Books Recommended:**

1. McKenzie L. David A. Cornwell 1991. Introduction to Environmental Engineering.
2. Tyagi, O.D. and M. Mehar, 1990. Environmental Chemistry, Report No.103. Agriculture and groundwater quality. Form Council for Agricultural Science and Technology.
3. Rosenberg, N.J. and Blad, B.L. Microclimate. 1983. the biological environment. 2nd edition, John Wiley and Sons, N.Y.

## **Environmental Management System in Industry 03**

Environmental Management System, benefits of an EMS, ISO 14000, principles behind the ISO 14000 series, trade issues associated with ISO 14000, ISO 14001 audits, Guidelines for Self-monitoring and Reporting by the Industry, Guidelines for Industrial Effluents and Gaseous Emissions, Categorization Of Industries, Pakistan Environmental Protection Act (1997), Legislation For Environmental Control. Cleaner Production Techniques for Industries.

### **Books Recommended:**

1. Crognale, G. 1999. Environmental Management Strategies: The 21st Century Perspective. Air and Waste Management Association, Sewickley, PA , USA.
2. Wall, J. D. 1980. Environmental Management Hand Book. Welf Publishing Co., London.
3. ISO 14000 Standards Manual
4. Pak EPA Act, 1997

### **Solids Waste Management**

**03**

Farm Wastes: Sources and types, bio-chemical properties of Wastes.Composition and generation rates. Waste handling and storage methods.Waste collection techniques. Transfer and transportation means and methods. Some typical wastes.

Recycling and Management: Recycling of wastes; By products of cereals,

legumes, oilseeds, fruits and vegetables. Crop, livestock and aquatic waste utilization in various industries, Fermentation of by-products and waste, Furnaces and boilers run on agricultural wastes and by-products, Generation of electricity using surplus biomass.

Identification of various agricultural wastes, study and operation of equipments used for size reduction, digesting and processing of wastes and by-products. Study and operation of equipment/machines used for utilizing various wastes, Incinerator. Study of techniques for bio-gas production utilizing plant and animal waste. Utilization of agricultural wastes for production of manure and animal feed.

### **Books Recommended:**

1. Jorgenser, S.E. 1992. Industrial Waste Water Management. Elsevier
2. Scientific Publishing Co., USA.
3. Grundey, K. 1988. Tackling Farm Wastes. Farming Press Ltd. Suffolk, England.
4. Muller, Z. O. 1982. Feed from Animal Production and Health FAO Paper No. 28.
5. Shuller, M. L. 1980. The Utilization and Recycle of Agricultural Wastes and Residues. CRC Press Inc. 2000 Corporate Blvd. N.W. Boca Raton Florida USA.
6. Irena, T. and H.E. Allen. 2004. Solid Waste Assessment Monitoring and Remediation.

## **Water Supply and Sewerage**

**3(2-1)**

Introduction: overview of water supply and sanitation in Pakistan; Health Aspects of Water Supply and Sanitation; Water availability standards. Water Supply: sources of water, Choices of water sources (spring, wells etc) and their protection. Design and construction of Tubewells, Dug wells and handpumps.

Forecasting population, Consumption for various purposes, Factor effecting consumption, Analysis Impurities in water, Physical tests, chemical tests, Bacteriological tests. Economics of community water supply, Planning and design of low cost water supply schemes. Water Treatment and Distribution : sedimentation tank, Coagulation, Flocculation, Usual coagulants, Mixing devices, Filtration, Filter sand, Classification of filters, disinfections, Chlorination. Sanitation: purpose of sanitation, Site for sewage treatment work, Water borne and helminth diseases and their control, Health and water chemistry, Planning and design of low cost sanitation. Composting and biogas, sanitation and irrigation, Agriculture and aqua cultural reuse.

### **Practical:**

Assessment of water supply demand of a community, Design of a water supply project Determination of physical, and chemical characteristics of drinking water, Determination of Bacteriological characteristics (Coliform count) of water and waste water. Visit to a drinking water treatment plant.

### **Books Recommended:**

1. Steel, W. Ernest. 1999. Water supply and Sewerage. McGraw Hill Book Co. USA.
2. Cairncross, S. and R.G. Feachem. 1993. Environmental Health Engineering in the Tropics. John Wiley and Sons, Inc., New York
3. Feachem, R.G., M. McGarry, and D. Mara, 1977. Water, Wastes and Health in Hot Climates. John Wiley & Sons, Inc., New York,

## **Meteorology and Climate Change**

**3(2-1)**

The Principles, Aims and Scope, Elements of Climate and Weather. Dynamics of Earth's Atmosphere. Radiation and Heating of the Atmospheric System, Atmospheric Moisture. The Dynamics of Pressure and Wind Systems, Condensation and the Precipitation Process, Seasonal Variations in Temperature Daylight, Radiation, Seasonal Variation in Rainfall and Evaporation. Equipment and Maintenance of a

Standard Meteorological Station, Measurement of Air Pressure, Wind Speed, Wind; Direction, Radiation and Sunshine Duration.

Measurement of Evaporation and Evapotranspiration and the Maintenance of a Standard Meteorological Station, Climate and Agriculture in the Tropics.

### **Practical:**

Determination of Pressure, Temperature, Humidity, Sunshine hours, Precipitation, Wet and Dry bulb thermometer and other weather parameters in a weather station.

#### **Books Recommended:**

1. Ayoade, J.O. (2004).Introduction to Climatology for the Tropics. Ibadan: Spectrum Books Limited.
2. Ayoade, J.O.(2002).Introduction to Agro Climatology. Ibadan: Vantage Publishers.
3. Donald Ahren C. (1994). Meteorology Today. An Introduction to Weather, Climate and the Environment (5th ed). U.S.A: West Publishing Company.
4. Ojo,O.et al (2001) .Fundamentals of Physical and Dynamic Climatology Lagos:SEDEC Publishers.

## **Environmental Impact Assessment**

**2(2-0)**

Introduction: EIA as a Tool for Sustainable Development, Process and Framework for EIA, Guidelines and Legal Aspects, Environmental Settings, Methodologies of EIA, Assessing Regional and Sectoral Level Impacts, Computational Modeling, GIS Applications, Knowledge Based Expert Systems and Soft computing Applications, Environmental Management Plan , Challenges in Preparation of EIA Reports, Case Studies of Engineering Projects , Future of EIA in Pakistan: Status, Problems and Remedial Actions

## **Solid and Wastewater Treatment**

**3(2-1)**

Introduction to water supply and wastewater. Why to treat water and wastewater. Water quality parameters and standards. Sedimentation and flocculation, Filtration, Chemical treatment and softening; chemical treatment-adsorption and ion exchange. Disinfection, Wastewater screening, primary treatment, biological reaction kinetics, stabilization ponds. Activated sludge treatment. Trickling filters, biological contractors,

nutrient removal sludge handling and sludge digestion. Modern methods of water purification and treatment.

### **Practical:**

Visit of small, medium and large water treatment plants and writing of a report on the functioning and maintenance of the plants.

Visit of wastewater treatment plants in urban areas and writing a report of the visit of plants.

### **Books Recommended:**

1. Mara, D. Domestic Wastewater Treatment in Developing Countries. London, UK: Earthscan, 2003. ISBN: 1844070190.
2. Viessman, W., Jr., and M. J. Hammer. Water Supply and Pollution Control. 7th ed. Pearson Education, Inc., Upper Saddle River, NJ: Pearson Prentice Hall, 2005. ISBN: 0131409700.
3. Droste, R. L. Theory and Practice of Water and Wastewater Treatment. Hoboken, NJ: Wiley & Sons, 1997. ISBN: 0471124443.

## **Water Quality and Pollution**

**3(2-1)**

Introduction: Definition and concepts, irrigation and drainage water quality, water quality terminology, water quality objectives, quality criteria and standards for irrigation water carcinogenic/non carcinogenic substances, water quality status in Pakistan.

Water treatment: Water pollution and their sources, water treatment techniques i.e. coagulation, softening, mixing and flocculation, sedimentation, filtration etc.

Drainage Effluents and Management Techniques: Sources of drainage water, characteristics, quality of drainage water, alternates for disposal of drainage water drainage water reuse techniques, crop management, soil management techniques, chemical management techniques, drainage and leaching fractions, concepts of preferential flow.

Agricultural chemicals and Groundwater Contamination: Agricultural chemical, their uses, trends and properties concept of nitrate nitrogen and pesticides transport ;through the soils, behavior of agricultural chemicals in flooded/water logged soils, management practices to avoid groundwater contamination.

**Practical:**

- ❖ Analysis of drainage water for irrigation purposes.
- ❖ Waste water analysis for BOP, COD and other chemicals.
- ❖ Visit to waste water treatment plants, drainage system and drainage reuse sites Use of computer software to assess non-point source pollution

**Books Recommended:**

1. McKenzie L. David A. Cornwell 1991. Introduction to Environmental Engineering.
2. Tyagi, O.D. and M. Mehar, 1990. Environmental Chemistry, Report No. 103. Agriculture and groundwater quality. Form Council for Agricultural Science and Technology.
3. Rosenberg, N.J. and Blad, B.L. Microclimate. 1983. the biological environment. 2nd edition, John Willey and Sons, N.Y.

**Course Title: Computer Aided Design****3(2-1)**

Threaded fasteners, keys, springs, Gears and Cams. Welding and Riveting. Electric, Plumbing and Architectural Drawings and Electronic drafting. Presenting data: Charts and graphs. Computers, computer graphics, and Computer Aided Drawing. Piping. Structural Drawings. Maps and Topography.

**Practical:**

Drawing and working problems in AutoCAD mechanical power pack package.

**Recommended Books:**

1. Introduction Engineering Drawing, by A.C. Parkinson. Pintman & Sons
2. Engineering Drawing and Graphics Technology, By T.E. French, C.J. Vierck and R.T. Foster. McGraw-Hill Illustrated AutoCAD, BPP Publications, India
3. Frey, D. (1999). AutoCAD 2000, 1<sup>st</sup> edition. BPB Publications, New Delhi.



## **Engineering Materials**

**3(3-0)**

### **Stones:**

Classification and characteristics of good building stones. Tests of stones. Quarrying and dressing of stones. Artificial stones and its varieties, preservation of stone work.

### **Tiles And Bricks:**

Different kinds of tiles. Manufacture and uses of tiles. Coloring and glazing of tiles. Fire tiles and bricks. Qualities of good bricks. Refractory bricks and ceramics.

### **Lime And Cement:**

Classification of lime. Properties and applications of lime. Types of cement. Manufacturing process of cement. Determination of initial and final setting time. Normal consistency.

### **Concrete And Mortars:**

Aggregates for concrete and mortars. Types of concrete. Water cement ratio. Workability of concrete. Compaction and curing of concrete. Types and uses of mortars. Tests for mortars.

### **Timber:**

Classification of trees, growth of timber trees. Methods of seasoning and sawing. Decay and preservation of timber, Laminated materials.

### **Metals:**

Composition and properties of ferrous and non-ferrous metals. Effect of various heat treatments on the properties of steel and its alloys. Methods of corrosion control.

### **Paints, Plasters And Varnishes:**

Composition, preparation, properties, tests and uses of paints, plasters, varnishes and distemper.

### **Miscellaneous Materials:**

Composition, varieties, properties and uses of glass, plastics, Laminates and adhesive. Properties and uses of asphalt, rubber and asbestos.

### **Recommended Books:**

1. Haider, S.Z. 1985 Materials of Construction (2nd edition), Oxford University Press, Pakistan
2. Surendra S. 1990 Engineering Materials. Vikas Publishing House (Pvt.) Ltd. 5 Ansari Road, New Delhi 110002
3. Kulkarni, G.J. 1980. Text Book of Engineering Materials. Union Book Stall, M.A Jinnah Road, Karachi.
4. Zaman, M.A. 1987 A text Book of Engineering Materials.

### **Rural Electrification**

**03**

#### **Objective:**

- To develop understanding regarding the concept / design of rural electrification project and its usage in various agro based activities, farm structure and house etc.

#### **Content:**

Benefits of electricity in agriculture, elementary transmissions and distribution, transformation voltage; basic principles, ratio of transformation, iron and copper losses; regulation, auto-transformers, 3-phase transformers, delta star connections, scot connection, constructional features and cooling of transformers; Electrical wiring practices: farmstead and farm houses; Radiation: types of radiation and application in agriculture; Resistance heating: units advantages and applications; Sensing elements and fundamentals of control: response to environmental factor like temperature, pressure, humidity, radiation etc. Selection of motors: single and three phase; Selection of electrical wires and distribution types; Electrical wiring, electrical distribution systems, electrical panel boards, one-way and two-way wirings/connections, single phase and three phase connections.

#### **Electricity Fundamentals:**

Nature of electric current, resistance and voltage, effect of temperature on resistance, specific resistance, Ohm's Law, units of power, arrangements of resistor in series and parallel, Kirchoff's Laws.

#### **Electric Machines:**

##### **A). Dc Machines:**

DC generator, working principle, construction and types. DC motors, working principle, construction and types

**B). Ac Machines:**

AC generators (Alternators), working principle and construction. AC motors operating principles, single and three phase motors, various types of motors.

**C). Transformers:**

Working principle, construction and types. EMF equation, ratio of transformation.

**Electric Instruments:**

Introduction to electric instruments, types & application of different electric instruments (Potentio-meter, strain gauges, electric transducers)

**Farmstead Distribution System:**

Electric load, types of distribution centers, locating the distribution center, selection of wire for feeder lines.

**Electricity for Water Supply And Cooling:**

Horsepower required for pumping, wiring devices and control, energy cost of water system, refrigeration cycle and refrigeration Control, calculating the product load and space load.

**Electricity for Heating:**

Advantages & disadvantages of electric heating, electric heating elements, electric heating equipment, under heat brooders, infrared brooders, electric hot bed.

**Electrical Control and Special Equipment:**

Switches, relays, push buttons, thermostats, time switches, floating switches, pressure switches, milk cooler, electric fences & feed processing equipment.

**Practical:**

- ❖ Safety and precautionary measures of use of electrical appliances in the machinery workshop and field.
- ❖ Study of construction of panels of wiring systems.

- ❖ Study of transformer types.
- ❖ Use of motors for different operations in the machinery workshop at farm buildings.
- ❖ Practice on repair and adjustment of electrical appliances. (motors, switches, fuses etc)
- ❖ Electrical power tools and their application in agriculture and village homes.
- ❖ Verification of Ohm's Law
- ❖ Verification of Kirchhoff's Law
- ❖ Verification of Kirchhoff's Voltage Law
- ❖ To study the construction of a transformer
- ❖ To study the construction of D.C/A.C machine
- ❖ Demonstration of an A.C Series and Parallel circuit
- ❖ Study of the different types of wiring system

### **Recommended Text Books:**

1. Farm electrical equipment handbook. 1950. Electrical institute. New York city USA.
2. Hinton, T. 1958. Electricity in agricultural engineering. John Willey and sons. N.Y city USA.
3. Bhagat, R. P. 1993. Rural Electrification And Development, ISBN: 8171004997 Deep & Deep Publications Pvt. Ltd. India.
4. Theraja, B. L. (2000). A Textbook of Electrical Technology, 21st Ed., Publication Division of Nirja Const. & Development Co., Pvt. Ltd., Ram Nagar-India.
5. Golding, E.W. and F.C. Widdis. (1990). Electric Measurements and measuring instruments, 5th edition. The English Language Book Society and Pitman Publishers.
6. Brown, R. H. (1956). Farm Electrification. McGraw Hill Book Co. New York.
7. Gustafson. (1980). Fundamental of Electricity for Agriculture. Van Nostrand Co.

### **Engineering Creativity**

**2(2-0)**

#### **CREATIVITY:**

Definition of creativity, characteristics of creative mind, need for teaching creativity in present day society, management of creative personnel, qualities of a good researcher and a research manager, creativity in graduate work, field and industry.

## **CRETIVITY AND PATENTS:**

Definition of patent, procedure to get and protect patents. Safety in design of machinery and liability of inventor. Class discussion on creative thoughts. Projects in creativity.

### **Books Recommended:**

1. Buchele, W.F. 1985. Solving Industrial Problems of Agriculture. Industrial Report, Department of Agricultural Engineering, Iowa State University, USA.
2. Stoops, J.K. 1977. The Child Wants to Learn, Little, Brown and Company, Canada.

### **Industrial Sociology:**

Introduction: Sociology and industrial sociology. Basic terms: work, occupation, industry, organization, factory, management. Industrialization: Antecedents of Industrialization in West. Process of Industrialization, Theories of Industrialization. Formal Organization: Bureaucracy, Trade Union, and Theories of Unionism. Work Ethics in Isla: Division of Labor, Work Ethics and Distribution of Wealth. Industry and Sociology: Industry and Social change. Industrialization in Pakistan: Historical view of Industrial development, Problems and Prospects of Industrialization in Sociological Perspective, Industrial Relationship in Pakistan. Trade Unionism in Pakistan: Labor movement, trade unionism, union leadership, and collective garaging. Labor Policies in Pakistan: Historical perspective, analysis of current prices.

### **Practical:**

The students will visits different industries to study human relations in industry. They will meet the employer and the employees to discuss their problems and submit a comprehensive report.

### **Books Recommended:**

1. Hall, R. H. 1995. Organizations: Structure, Process and Outcomes, 6th Ed. Prentice Hall, Englewood Cliffs., California.
2. Theoblad. 1994. Understanding Industrial society: A Sociology Guide. St. Martin's Press, New York.
3. Scott, W. R. 1992. Organization: Rational Natural and Open systems, 3rd Ed. Prentice Hall, Englewood Cliffs, California.

4. Grint, K. 1991. The sociology of work: an introduction. Polity Press, UK.
5. Schneider, E. V. Industrial Sociology. McGraw Hill Publishing Company, New York

## **Rural Sociology**

### **Objective:**

- Enabling to develop understanding regarding social issues, culture, system and knowledge / competency to design / analyses various relevant social aspect / data

### **Content:**

Introduction: Field of Rural Sociology; Rural Sociology as a Science; Rural Sociology and Other Social Sciences. Basic Concepts and Processes: An understanding of the Rural Social System, Caste and "baradari" structure, Factions, dispute and "We-groups", Problems of small and fragmented holding, landless tenants and agricultural labor. Social stratification and social differentiation.

Basic Concepts and action: Group, Role and Status, Norms and Values, Folkways and Mores, Social Systems and Sub-systems: Culture. Socio Processes: Cooperation, Competition and Conflict; Acculturation, Accommodation and Assimilation. Social Institutions: Rural Social Institutions: Definition, Functions, Description and Analysis of the Social, Economic, Political and Religious Institutions. Social Change: Introduction, Factors in Acceptance and Resistance to Change, Role of Extension Worker as Change Agent. Main concepts development and problems in agrarian rural society. Small scale farming. Feudalism. Capitalism. Family farming. Agrarian politics and village development. Relationship between technological and socio economic aspect of rural society. Gender and Development. Role and status of Rural Woman. Pattern of Rural Settlement, Rural Resources, Land Tenure System, size of landholdings. Rural Social structure, provision of services in rural area; health, education and sanitation etc. Questionnaire (types, development and analyses) and conflict resolution, crime as a social and cultural phenomenon, culture based crime, gender and development.

### **Books Recommended:**

1. Chitamber, J.B. 2003. "Introductory Rural Sociology", 2nd Edition, New Age International (P) Limited Publisher, New Delhi.
2. Dalal, B.2003. Rural Planning in Developing Countries, New Delhi, Earthscan.

3. Setty, E.2002, New Approaches to Rural Development Amal Publications Pvt. Ltd.
4. Social Policy and Development Centre.2000. Social Development in Pakistan, New York, Oxford University Press.
5. Shepherd,Andrew(2000)Sustainable Rural Development,Allam Iqbal Open University,Islamabad.
6. Khan, Nowshad (2000) Rural Poverty Alleviation, National Book Foundation, Islamabad
7. Sahibzada, Mohibul Haq. 1997. Poverty Alleviation. Institute of Policy Studies. Islamabad.
8. Chaudhry, Iqbal, 1995. Sociology. Aziz Publication, Lahore.

## **COURSES FOR SOCIAL SCIENCE**

### **Sociology and Development** (For Engineers)

#### **Objective:**

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 subordinates 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.

#### **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 Behavior
- 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 7UPU the UPU 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). UPower and civil society in PakistanU, Oxford University press.

## Surface Water Hydrology

03

Hydrologic processes: Introduction, Hydrologic cycle and its components, importance of hydrology, climatic factors, estimation of precipitable water, snowcover and snow fall, stream flow, water stage, discharge, interpretation of stream flow data evaporation and transpiration, Evapotranspiration and its estimate using different methods.

Hydrologic Analysis: Hydrograph and its characteristics, Run off and its components, recessions, hydrograph separation, rainfall-runoff relations, phenomenon of runoff estimating the volume of storm runoff, estimating snow melt runoff, seasonal and annual runoff relations, hydrograph of runoff unit hydrograph its derivation and application, overland flow.

Hydrologic routing: Introduction, River routing level pool routing, linear reservoir model, Muskingam method.

Hydrologic Models: definition, classification of models, development, calibration, verification and application of models.

### Practical:

- ❖ Demonstration of weather recording instruments and practice in taking actual data from weather stations including a visit to weather station.
- ❖ Measuring runoff in the field by different techniques.
- ❖ Development of unit hydrograph and its use.
- ❖ Frequency analysis of rainfall data.
- ❖ Measuring infiltration rate in the field.

### Books Recommended:

1. Awan, N.M. 1981. Surface Water Hydrology, National Book Foundation, Islamabad.
2. Linsely, R.K., Kohler, J.L.H. Paulhyus 1996. Hydrology for Engineers, SI. Edition, McGraw Hill Kogakusha Ltd.
3. ard, R.C., Robinson, M. 1990. Principles of Hydrology, McGraw Hill Book Co., London.
4. Wilson, E. M. 1990. Engineering Hydrology, Macmillan Civil engineering hydraulics .N.Y.

## **Irrigation Scheduling:**

Irrigation scheduling definition and concept, factors to be considered in irrigation scheduling, types of irrigation scheduling, application of irrigation scheduling. Soil and soil water content, types of soil water, soil and water characteristic curve, Methods of determining crop water requirements.

Consumptive use, actual evapotranspiration, potential evapotranspiration, crop coefficients. Methods of determining evapotranspiration.

Frequency and Interval of Irrigation, Factors affecting frequency of irrigation, Design irrigation frequency, depth of irrigation, factors affecting depth of irrigation

## **Practical:**

Determining moisture contents at field capacity and wilting points by gravimetric method. Estimating reference evapo-transpiration. Preparing an irrigation schedule of a crop for the growing season. Use of Computer model for calculation of the water requirements for different crops.

## **Books Recommended:**

1. Dilip K. M. 2004. Irrigation Water Management Principles and Practices. Prentice Hall of India Pvt. New Delhi.
2. FAO 1977 Crop water requirements (revised ed.) FAO irrigation and drainage paper 24.
3. Rafique M. C. 2005. A text book of irrigation and drainage practices for agriculture. Study Aid Project. University of Agriculture, Faisalabad.

## **Soil Physics:**

Introduction: Definition of soil and its important for plant growth. Composition and formation of soils. Soil classification & Horizons. Soil colour and temperature.

**Soil physical properties:** texture and structure, water content, bulk density, particle density, porosity, void ratio, saturation capacity.

**Soil water Potential:** components of total potential, measurements of potential components, capillary tube, tensiometer, piezometer tube.

**Saturated water flow:** Darcy's law, measurement of the saturated hydraulic conductivity in the lab and field.

**Unsaturated water flow:** retention curve and hydraulic conductivity function, measurement of retention curve, Richards equation, infiltration, evaporation, non-equilibrium/preferential flow.

**Soil hydraulic parameters their measurements:** VGM parameters and analytical models RETC, ROSETTA for measurement of hydraulic parameters. Introduction of numerical models (HYDRUS) for modeling of water flow in soil.

### **Practical:**

Determination of soil texture, soil structure, soil water content, soil bulk density, soil particle density, void ratio, porosity. Determination of saturated and unsaturated soil hydraulic conductivity. Determination of water retention curve. Laboratory practices with Hydrus-1D model.

### **Books Recommended:**

1. Baver, L.D. 1956. Soil Physics. John Wiley and Sons Inc., New York; Chapman and hall, Limited, London
2. Buckman, H.O. and Brady, N.C. 1961. The Nature and Properties of Soils. The macmillan and Co., New York
3. Hillel, D. 1982. Introduction to soil physics. Harcourt Brace Javanoich, New York.

### **Farm Machinery Management:**

Machine performance: Machines capacities; time efficiency; machine manoeuvrability; field patterns, factors effecting machine performance.

Power performance: Tractor power; draw bar power; PTO power, hydraulic power, power measurement; tractor tests, Nebraska Tractor Tests.

Ergonomics: Introduction, operator skill, operator aids for control, machine sensors, GPS role in machine control, operator safety and environment

Machinery Management: Machinery costs - ownership costs, operating costs, and timeliness costs; machinery selection and replacement.

Optimization: optimum use of machine, estimation of power for a machine, part load operation, break even point, linear programming.

Hay and Forage harvesting: Mechanics of cutting plants; mowers; mower conditioners, balers; impact cutting; curing and preservation of forage; wind rowing.

Grain harvesting: Introduction, methods and equipment, reaper and windrowing; types of threshers, threshing cylinders, threshing losses, combine harvesting: types of cutting heads and tracks for different crops(wheat, rice, maize, sunflower), functional processes - gathering, cutting, pickup, feeding, threshing, separation, cleaning; combine losses and adjustments, performance evaluations.

Special crop machines: Cotton harvester; maize harvester; sugarcane harvester; potato harvester. Precision Farming: Introduction, precision farming methods, precision equipment- laser land leveling, sensors, variable rate application, role of GIS and GPS in precision farming.

### **Practical:**

- ❖ Measurement of Drawbar and PTO power of a tractor.
- ❖ Calculation of field capacity of selected farm machinery.
- ❖ Demonstration of reaper and thresher.
- ❖ Demonstration of combine harvester.
- ❖ Measurement of combine losses.
- ❖ Measurement of maturity level of crop.
- ❖ Thresher and Combine adjustments to solve grain breakage problem.
- ❖ Study of cost analysis of combine harvesting.
- ❖ Demonstration of laser land leveller and its adjustments.
- ❖ Demonstration of GPS for precision farming.

### **Books Recommended:**

1. Hunt, D. 2003. Farm Power and Machinery Management. Iowa State University Press, Ames, Iowa, USA.
2. Kepner, R. A., R. Bainer, and E.L. Barger. 2000 Principles of Farm Machinery, John Willey and sons, N.Y
3. Suresh, R. and S. Kumar. 2004. Farm power and machinery engineering. Standard Publishers, New Delhi, India
4. Klenin Popov & Sakun, 1995. Agricultural Machines. Kolos Publishers Moscow, U.S. S.R.

### **Land Development Machinery:**

Review of Machines: Classification of off-road power machines. Objectives, and scope of off-road machines, productivity of labor, and machines, effective productivity. Techno-economical factors, effect of compressibility, resistance of cutting and its effect. ¶Bulldozer: Role of

bulldozer in earth work, mechanical operation, development of bulldozer, working organ of bulldozers, tractive force, excavators, methods of excavation of earth work. Uni-cup excavator, productivity and types of Uni-cup excavator, trenchers, backhoe, trench plows, wheel trenchers, applications, parts, factor affecting, performance of machines, selection of machines. Digging speeds, characteristics of the machines. Graders and auto graders, cranes, scrapers. Maintenance of Off-road machines, endless type drainage trenching machines, chain trenchers, loaders, tractor hydraulic loaders, types, application of loaders. LASER beam technology, comparison of crawler and wheel types tractors.

### **Practical:**

- ❖ Visit of Agriculture Engineering and Machinery Management Workshops. Report Writing.

### **Books Recommended:**

1. Wong, Willey. 1984. Theory of Ground Vehicle. McGraw Hill Co. New York.
2. Bainer, R., B.A. Kepner and E.L. Barger. 1992. Principles of Farm Machinery, John Willey and Sons Inc. New York.

### **Theory of Structure:**

Soil bearing properties of soils and design of foundation. Theory and design of reinforced concrete beams, slabs and columns. Analysis of Indeterminate structures by the application of the methods of three moments, slope deflection, column analogy and conjugate beam. Advanced problems for the determination of slope and deflection by the application of Castigliano's theorem. Design problems and special numerical exercises.

### **Books Recommended:**

1. James, L. M. 1996. Concrete Technology. McDonald and Edward (Longman Group) London.
2. Wang, C. K. 1992. Indeterminate Structural Analysis. McGraw Hill Book Co., New York.
3. Kenneth, M.L. and M.U. Chia. 2005. Fundamentals of Structural Analysis.

## **B.Sc. (Hons) Agriculture 2<sup>nd</sup> Term**

### **Agricultural Engineering:**

#### **Theory:**

Definition, Fields of activities, and Importance of Agricultural Engineering.

Farm Power Sources of Farm Power: Animal, Wind, Water, Electric, and Heat Engine Power Tractor: Definition, importance, types, selection criteria, maintenance, hydraulic, and PTO of a tractor.

Farm Machinery: Classification, objectives, selection and storing of farm machinery. Tillage Equipment: Primary tillage equipment- Moldboard plow construction and types, moldboard parts and its classification, and disk, chisel, rotary, subsoiler and giant plow.

Secondary tillage equipments – Harrows, land rollers and types, and pulverizers, cultivators, rotavator, and drags.

Planting Equipment: Grain drill construction and its types, planter, and transplanter.

Fertilizing Equipments: Granular fertilizer application machines construction and types, manure spreader construction, and liquid and gas applicator.

Plant protection Equipments: Manual sprayers and its types, power sprayers' construction and its types, dusters construction and its types.

Harvesting Equipments: Reaper, thresher, and combiner's construction and types.

#### **Practical:**

- ❖ Farm Power  
To study and demonstrate the hydraulic, and PTO system of a tractor.
- ❖ Farm Machinery  
To study the construction and working of primary and secondary tillage equipment, Grain drill, and harvesting equipment used locally.

**Books Recommended:**

1. Farm Gas Engines and Tractors, 4<sup>th</sup> Edition, by Fred R. Jones.
2. Farm machinery and Equipment, by Haris Pearson Smith A.E.
3. Basic Farm Machinery, 3<sup>rd</sup> Edition, by J.M. Shipen, C.R.Ellin and C.H. clover.
4. Field Harry L. Roth Lawrence O. Introduction To Agricultural Engineering. Chapman & Hall