CURRICULUM
OF
AGRICULTURAL ENGINEERING
BS/BE/BSc
(Revised 2010)

HIGHER EDUCATION COMMISSION
ISLAMABAD
CURRICULUM DIVISION, HEC

Dr. Syed Sohail H. Naqvi  Executive Director
Prof. Dr. Altat Ali G. Shaikh  Member (Acad)
Ms, Ghayyur Fatima  Director (Curri)
Dr. M. Tahir Ali Shah  Deputy Director (Curri)

Composed by: Ms. Pakeezas Yousuf, HEC, Islamabad
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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 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

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

A committee of experts comprising of conveners from the National Curriculum Revision of HEC in 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:

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<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tr>
<td>Prof. Dr. Zahid Mehmood, Chairman</td>
<td>Convener</td>
</tr>
<tr>
<td>Department of Agriculture Engineering,</td>
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<td>NWFP University of Engineering &amp; Technology,</td>
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<td>Peshawar.</td>
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<td>Prof. Dr. Abdul Rehman Tahir</td>
<td>Member</td>
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<td>Department of Farm Machinery,</td>
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<td>University of Agriculture,</td>
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<tr>
<td>Prof. Dr. Maqsood Ahmad,</td>
<td>Member</td>
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<tr>
<td>Department of Environmental Management &amp; Policy,</td>
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<td>Baluchistan University of Information Technology,</td>
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<td>Engineering &amp; Management Sciences, (BUITEMS),</td>
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<td>Quetta.</td>
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<tr>
<td>Dr. Muhammad Saffar Mirjat,</td>
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<tr>
<td>Professor, Department of Irrigation &amp; Drainage,</td>
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<td>Sindh Agriculture University,</td>
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<td>Prof. Dr. Faizan ul Haq Khan,</td>
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<tr>
<td>Chairman, Department of Structures &amp; Environmental</td>
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<tr>
<td>Dr. Nasir Mahmood Khan,</td>
<td>Member</td>
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<tr>
<td>Additional Registrar, Pakistan Engineering Council,</td>
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<tr>
<td>Attaturk Avenue (East), G-5 / 2,</td>
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<tr>
<td>Islamabad.</td>
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Mr. Muhammad Naveed Aslam,  
Lecture,  
University College of Agriculture & Environmental Sciences,  
The Islamia University,  
Bahawalpur.  

Engr. Iqbal Zeb Khattak,  
Faculty of Agriculture, Gomal University,  
Dera Ismail Khan.  

Dr. Muhammad Naeem Chaudhry,  
Assistant Professor,  
University College of Agriculture & Environmental Sciences,  
The Islamia University,  
Bahawalpur.  

Prof. Dr. Jehangir Khan Sial  
Head / Professor  
Department of Agriculture Engineering  
Bahauddin Zakariya University,  
Multan.  

Proceedings of Preliminary Meeting:  

The meeting started with the recitation from Holy Quran by Mr. Bashir Ahmad, Director HEC Regional Center, Lahore. Mr. Shafiuallah, 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, Fataha 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

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<th>Lec CH</th>
<th>Lab CH</th>
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* Math/Physics/Chemistry/Biology/Engineering Economics or related subject as appropriate for the program
## BS ENGINEERING PROGRAM

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<td>Soil Science</td>
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<td>Farm Power</td>
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<td>Mechanics of Materials</td>
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<td>Statistics &amp; Probability</td>
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<td>Drainage Engineering</td>
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<td>Soil &amp; Water Conservation Engineering</td>
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<td>Course</td>
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<td>Irrigation Engineering</td>
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<td>Environmental Engineering</td>
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<td>Instrumentation &amp; Measurements</td>
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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 4th semester
2. A supervised internship training to be arranged by the institution after 6th 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

<table>
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<tr>
<th>Domain</th>
<th>Knowledge Area</th>
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<th>% Overall</th>
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<td>Major Based Core (Depth)</td>
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<td>Inter-Disciplinary Engineering Breadth (Electives)</td>
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<td>Senior Design Project</td>
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<td>Total</td>
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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.
Linear Algebra and Calculus

Objective:
- To learn fundamentals of algebra & calculus.

Vector Algebra:
Introduction to scalars and vectors, vectors in a plane, scalar and vector products, Line in $\mathbb{R}^2$, $\mathbb{R}^3$ 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:

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 Taylor’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

**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:**

**Fluid Mechanics 3(2-1)**

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

Engineering Drawing & Graphics

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:


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.


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:


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:

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:
English Composition and Comprehension 3(2-1)

Objective:
- To enhance students' language skills and develop their critical thinking.

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:
Objective:

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

Contents:

Soil Formation:


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 Westergard 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, Soil Samples, Disturbed and Undisturbed 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:**

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 planning: shaper; classifications, functions, shaper drive mechanism, shaper speeds and machining times, planning, 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:


Engineering Mechanics

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:


Applied Physics 3(2-1)

Objective:

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

Contents:


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:

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:**

**Engineering Thermodynamics**

**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.


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, CO2, NO2, 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:

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 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:

Surveying and Leveling

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 Trignometric 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 Coordinates

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:**

**Computer Programming and Applications in Engineering**

**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++, application of C++ 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++.

**Books Recommended:**
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’ 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:

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:
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.


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, supper charger, 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:

Mechanics of Materials

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.

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:

Farm Structures & Materials

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 nonhomogenous 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:

Soil Science

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

Contents:

Soil Perspective:

Important Physical Properties of Mineral Soils:

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:

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:
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:
2. Hargie, O. (ed.) Handbook of Communications Skills

Statistics & Probability 3(2-1)

Objective:
- The basic concepts of application of probability and statistics in the agricultural engineering
Contents:
Statistics:

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.
- Historogram, 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 x2-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.

Recommended Books:
Irrigation Engineering

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 charges
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

**Machine Design**

**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:


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:

Instrumentation and Measurements

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.


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:

SEMMESTER - 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:

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:

4. Responsibilities and Rights:

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:**

2. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999

**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:**


**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

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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:


GIS & Remote Sensing

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:
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.

**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:**


**Wind Erosion:**

Rainfall and Runoff:

Cropping System and Agronomic Measures For Erosion Control:
Watershed management, Plant cover, Crop rotation, Strip-cropping, Conservation tillage, Contour cultivation, Land capability classification.

Terracing:

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:

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:

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:
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:**


**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:**

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-getation 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:**

**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:


SEMESTER – 8

Engineering Elective IV 03
Engineering Elective V 03
Engineering Elective V1 03
Engineering Economics & Management 03

Management Fundamentals:

Project Scheduling And 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:


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

Recommended Books:


Project –II

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:

4. Khana Publishers, New Delhi, India.

Soil Dynamics


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

Practical:

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

Books Recommended:


Pumps and Tube wells

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:

Water Management Engineering

Water Course Design And Improvement:

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 plane and work plane, 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:


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)
   c. Vol.VI Irrigation Agronomy.
   e. Vol. X Water Harvesting and Spate Irrigation
      Ministry of Food, Agriculture and Livestock (Federal Water Management cell) Government of Pakistan, Islamabad.

Ground Water Hydrology

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, Peizometers, 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:

4. Ahmad, N. 1985. “Ground water Resources of Pakistan” Shahzad Nazir Publisher, Gulberg-III, Lahore

Farm Irrigation Systems

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:


Reference Books:

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)


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:


Project Planning and Management

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:


Irrigation Water Management Techniques 3(2-1)


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.


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:

3. Jensen, M.E. 1981, Design and Operation of Farm Irrigation System. ASAE, Monograph, USA

Drainage of Irrigated Lands

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 perorated 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:**


**Land Reclamation**


**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:**


**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,

**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:


Boiler Engineering and Power Plants

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:


Energy Resources and Management

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.


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

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:


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 windrow; 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:
   State University Press, Ames, Iowa, USA.
   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
   Publishers Moscow, U.S. S.R.

Post Harvest Engineering

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:

Industrial Engineering and Management

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.


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 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:


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 Parameters.

Recommended Books:


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.
Draingage 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:

3. Rosenberg, N.J. and Blad, B.L. Microclimate. 1983. the biological environment. 2nd edition, John Willey and Sons, N.Y.

Environmental Management System in Industry

Books Recommended:

3. ISO 14000 Standards Manual
4. Pak EPA Act, 1997

Solids Waste Management 03


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:

2. Scientific Publishing Co., USA.
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 aquacultural 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:

Meteorology and Climate Change 3(2-1)

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:**


**Environmental Impact Assessment**


**Solid and Wastewater Treatment**

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,

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:

Water Quality and Pollution

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 use sites 
  Use of computer software to assess non-point source pollution.

Books Recommended:

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)


Practical:

Drawing and working problems in AutoCAD mechanical power pack package.

Recommended Books:

1. Introduction Engineering Drawing, by A.C. Parkinson. Pintman & Sons
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:

Lime And Cement:

Concrete And Mortars:

Timber:

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:
2. Surendra S. 1990 Engineering Materials. Vikas Publishing House (Pvt.) Ltd. 5 Ansari Road, New Delhi 110002

Rural Electrification 03

Objective:
- To develop understanding regarding the concept / design of rural electrification project and its usage in various agro based activates, 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 alliances. (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:**


**Engineering Creativity**

**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.
CREATIVITY 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:

   Industrial Report, Department of Agricultural Engineering, Iowa
   State University, USA.
   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:

   systems, 3rd Ed. Prentice Hall, Englewood Cliffs, California.

Rural Sociology

Objective:

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

Content:


Books Recommended:


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:


**Surface Water Hydrology**

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 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:**

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:


Books Recommended:


Soil Physics:


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:

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; mover conditioners, balers; impact cutting; curing and preservation of forage; windrowing.
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:

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

Practical:


Books Recommended:


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:

B.Sc. (Hons) Agriculture 2nd Term

Agricultural Engineering:

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


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.


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:

2. Farm machinery and Equipment, by Haris Pearson Smith A.E.
4. Field Harry L. Roth Lawrence O. Introduction To Agricultural Engineering. Chapman & Hall