

**CURRICULUM
OF
AGRICULTURE ENGINEERING**

(Revised 2005)



**HIGHER EDUCATION COMMISSION
ISLAMABAD**

CURRICULUM DIVISION, HEC

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PREFACE

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

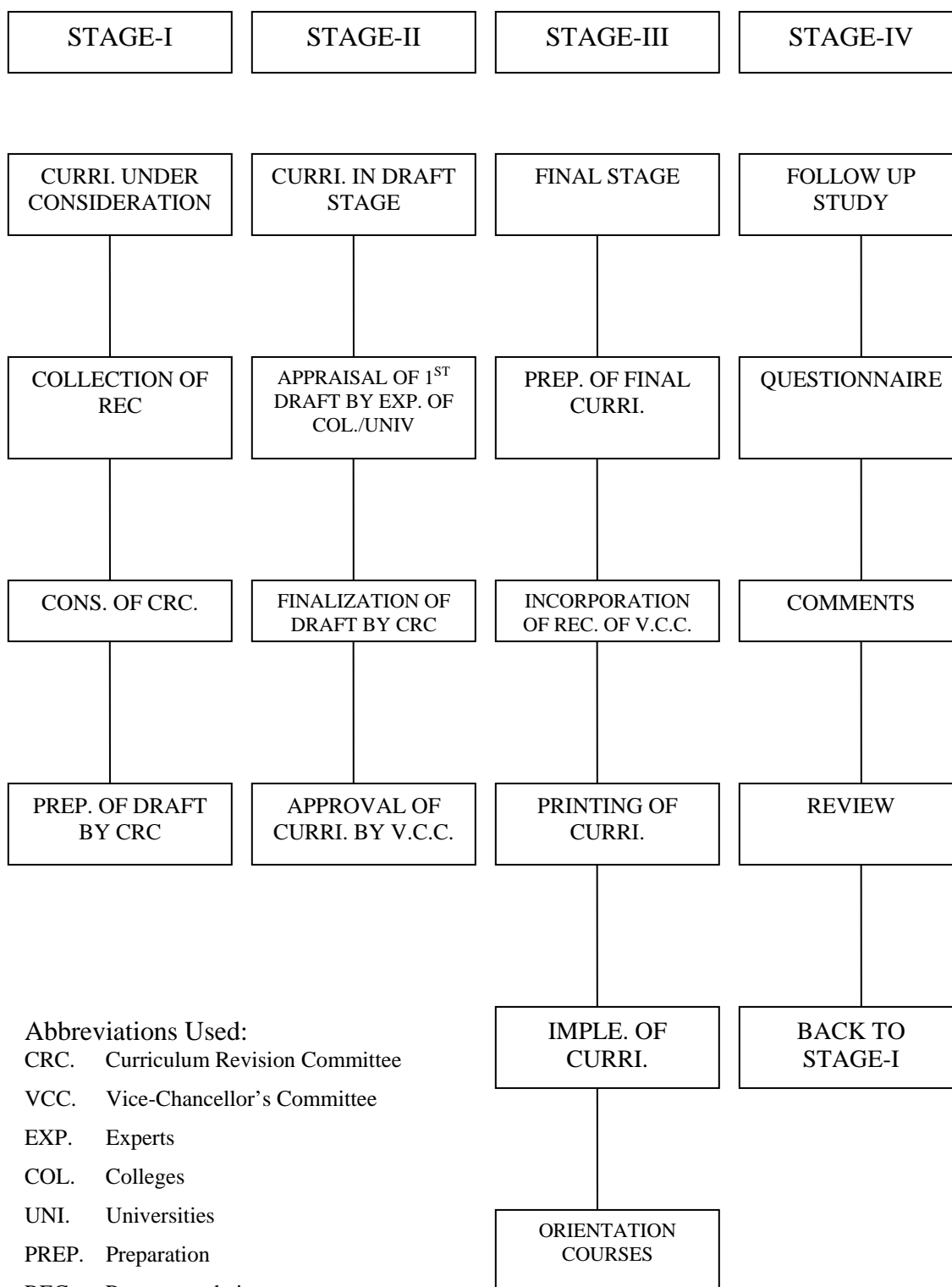
In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification no. D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at 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-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various committees are constituted at the national level comprising senior teachers nominated by universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these committees. The National Curriculum Revision Committee for Agriculture Engineering in its meeting held in July 21-23, 2005 at the HEC Regional Centre, Lahore revised the curriculum after due consideration of the comments and suggestions received from universities and colleges where the subject under consideration is taught. The final draft prepared by the National Curriculum Revision Committee duly approved by the Competent Authority is being circulated for implementation by architectural institutions.

(PROF. DR. ALTAF ALI G. SHAIKH)
Adviser (Acad/R&D)

July 2005

CURRICULUM DEVELOPMENT



INTRODUCTION

A meeting of National Curriculum Revision Committee to finalize draft curriculum prepared by the NCRC committee for the subjects of Agricultural Engineering was held at HEC, Regional Centre, Lahore from July 21-23, 2005.

The following attended the meeting:

1. Dr. Muhammad Shafi Sabir, Convener
Dean,
Faculty of Agricultural Engg. & Tech.,
University of Agriculture, Faisalabad.
2. Prof. Badruddin, Member
Department of Agricultural Engineering
NWFP University of Engg. & Tech. Peshawar.
3. Engr. Dr. Muhammad Azam Khan Member
Department of Agriculture Engg.
Faculty of Agriculture,
Gomal University, D.I.Khan.
4. Mr. Murad Ali Member
Assistant Professor,
Department of Water Management,
NWFP University of Agricultural, Peshawar.
5. Dr. Muhammad Yasin Member
Director,
Directorate of Agricultural Mechanization,
Research Institute (AMRI), P.O. Box-416,
Old Shujabad Road, Multan
6. Engr. M. Asghar Rana Member
Associate Professor,
University College of Agriculture,
B.Z. University, Multan
7. Dr. Ghazanfar Abbas Member
Principal Staff Officer-Wheat
National Agriculture Research Council,
Islamabad.

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| 8. | Mr. M. Masood
Assistant Professor,
Centre of Excellence in Water Resources,
University of Engg. & Technology, Lahore | Member |
| 9. | Dr. Muhammad Rafiq
Chairman,
Department of Irrigation and Drainage,
University of Agriculture,
Faisalabad. | Member |
| 10. | Dr. Muhammad Saffer Mirjat,
Professor,
Department of Irrigation and Drainage FAE,
Sindh Agriculture University,
Tandojam | Member |
| 11. | Engr. Muhammad Kamran Zaheer,
Asstt. Manager Marketing,
Al-Ghazi Tractor Sheikhpura Road,
Lahore. | Member |
| 12. | Prof. Abdur Rehman Tahir
Chairman,
Deptt. of Farm Machinery and Power,
University of Agriculture,
Faisalabad. | Member/Secretary |

The meeting started with the recitation from Holy Quran by Dr. Altaf Ali G. Sheikh, Adviser, HEC.

Dr. Altaf Ali stated the objectives and purpose of the Curriculum Revision Committee i.e. to bring uniforming in the degrees of B.Sc. Agri. Engineering being offered at different campuses through out Pakistan. In this context he added that a minimum credit hours requirement of 160-165 has been set by HEC keeping in view the national and international standards. A deviation of 15 to 20% in courses/content is expected to implement the revised curriculum at different campuses. Dr. Altaf was of the opinion that 30-35 credit hours should be given for M.Sc. degree programme. This may be divided into 24

credits for theory and 6 credits for thesis. One to two courses in communication skills at undergraduate level should be introduced. Mathematics has been recognized as mother of all the discipline in this modern age. Particular for engineering, two to three courses of mathematics should be declared compulsory.

Dr. Altaf briefed the committee about different programmes being executed by HEC. He advised the committee to encourage the faculty members at different campuses to avail grant for participation in national and international conferences. He also emphasized on the write up of Monograph and Text Books for which Rs.60,000/- to Rs.100,000/- is awarded to the author alongwith 100 copies of the book

At the end the committee members showed concerned about the introduction of three different curriculums of B.Sc. Agri. Engineering within the time span of four years, which increases academic and administrative problems. The committee suggested that in future, it should be much better if only HEC supervises the curriculum revision and not the provincial authorities.

**SCHEME OF STUDIES
FOR
B.Sc. AGRICULTURAL ENGINEERING DEGREE PROGRAMME**

SEMESTER – 1st

	COURSE	Credit hours
1	Engineering Graphics	2(1 – 2)
2	Surveying and Leveling	4(2 – 4)
3	Engineering Statics	3(2 – 2)
4	Fluid Mechanics	3(2 – 2)
5	Metallurgy and Workshop Practices	3(2 – 2)
6	Applied Mathematics	3(3 – 0)
7	Basic Agriculture	3(2 – 2)
	Total	21(14 – 14)

SEMESTER – 2nd

	COURSE	Credit hours
1	Engineering Materials	2(2 – 0)
2	Mechanics of Materials	3(2 – 2)
3	Hydraulic Machinery	3(2-2)
4	Manufacturing Engineering	3(2 – 2)
5	Engineering Thermodynamics	4(3 – 2)
6	Soil Science	3(2 – 2)
7	Applied Physics	3(2 – 2)
	Total	21(15 – 12)

SEMESTER – 3rd

	COURSE	Credit hours
1	Computer Aided Drawing	2(1- 2)
2	Engineering Dynamics	3(2 – 2)
3	Surface Water Hydrology	3(2- 2)
4	Soil Mechanics	3(2 – 2)
5	Instrumentation and Mechatronics	3(2 – 2)
6	Advanced Mathematics for Engineers	3(3 – 0)
7	Industrial Chemistry	3(2 – 2)
	Total	20(14 – 12)

SEMESTER – 4th

	COURSE	Credit hours
1	Theory and Design of Structures	2(2- 0)
2	Environmental Engineering	2(1 – 2)
3	Soil Dynamics	3(2 – 2)
4	Open Channel Hydraulics	3(2 - 2)
5	Boiler Engineering and Power Plants	3(2 – 2)
6	Processes Engineering	3(2 – 2)
7	Computer Programming and Application	3(2 – 2)
8	Technical Writing	2(2 – 0)
	Total	21(15 – 12)

SEMESTER – 5th

	COURSE	Credit hours
1	Ground Water Hydrology	2(1- 2)
2	Soil and Water Conservation Engineering	3(2 – 2)
3	Water Quality Management	2(1- 2)
4	Energy resources and Management	3(2 – 2)
5	I-C. Engines and Tractors	3(2 – 2)
6	Farm Machinery	3(2 – 2)
7	Islamic Studies OR Ethics (For Non_Muslims)	2(2 – 0)
8	Pakistan Studies	2(2 – 0)
	Total	20(14 – 12)

SEMESTER – 6th

	COURSE	Credit hours
1	Environmental Management system in Industry	3(3- 0)
2	Irrigation Engineering	3(2 – 2)
3	Pumps and Tube-wells	3(2 – 2)
4	Computational Engineering	3(2 – 2)
5	Farm Power	3(2 – 2)
6	Machine Design	3(2 – 2)
7	Economics for Engineers	3(3 – 0)
	Total	21(16 – 10)

SUMMER SEMESTER

Internship	4(0 – 8)
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SEMESTER – 7th

	COURSE	Credit hours
1	Bio-solids Management	2(2-0)
2	Principles and Application of Remote Sensing	3(2 - 2)
3	Farm Irrigation Systems	3(2 – 2)
4	Drainage Engineering	3(2 – 2)
5	Farm Machinery Management	3(2 – 2)
6	Applied Engineering Statistics	3(2 – 2)
7	Communication Skills	2(2 – 0)
	Total	19(14 – 10)

SEMESTER – 8th

	COURSE	Credit hours
1	Farm Structures	3(2 – 2)
2	Water Management Engineering	3(2 – 2)
3	Design of Agricultural Machinery	3(2 – 2)
4	Post Harvest Engineering	2(2 – 0)
5	Industrial Engineering and Management	3(2 – 2)
6	Project & Report	2(0 – 4)
7	Numerical Analysis	2(2 – 0)
	Total	18(12 – 12)

Total Credit Hours :

165 (114 – 102)

DETAIL OF MAJOR AND MINOR CREDIT HOURS 4 years B. Sc. Agri. Engineering Degree Programme

Semester	Major Credit Hrs	English/Islamic Studies/Pak. Studies	Math-Stat/ Phys/ Chem//Computer	Agri/Economics/ Communication Skills	Total
1 st	15	-	3	3	21
2 nd	15	-	3	3	21
3 rd	14	-	6	-	20
4 th	16	2	3	-	21
5 th	16	4	-	-	20
6 th	18	-	-	3	21
Summer	4	-	-	-	4
7 th	14	-	3	2	19
8 th	16	-	2	-	18

Total Credit Hours = 165

Major = 128

Supporting = 37

DETAILS OF COURSES

Engineering Graphics

2(1-2)

Graphics instruments and their use, Construction geometry. Orthographic and Isometric drawings and sketching. Sectional views and conventions. Pictorial drawing and sketching. Dimensions and tolerances. Lines and planes explored. Developed views. Introduction to Design. Production drawings. Introduction to Computer Aided Drawing (CAD).

Practical

Production drawings of different machine parts and assemblies.

Books Recommended

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

Surveying and Leveling

4(2-4)

Surveying definition, classes of surveys, description and uses, surveying measurements, field notes, measurement of distance, standardization of chain, direct and reciprocal ranging, sources of errors, mistakes and checks.

Taping and chaining: Taping and chaining procedures, taping and chaining over level and slopy ground, taping and chaining corrections, chain surveying, obstacles.

Traverse surveying: Introduction, traverse configuration, traverse surveying with prismatic compass, bearings and local attraction, graphical adjustment.

Theory of plane table surveying, comparison of different methods, advantages and disadvantages of plane table surveying.

Theory of leveling: Different types of hand and tripod levels, essential parts of a level, leveling staff, differential leveling, curvature and refraction, reciprocal leveling.

Application of leveling

Contouring, characteristics and uses, methods of contouring, uses of contour maps.

Theodolite: Construction, care and adjustment, reading horizontal and vertical angles.

Computation of areas of regular and irregular figures: The mid ordinate, average ordinate, trapezoidal and Simpson's rules; borrow pits, planimeter its construction and uses.

Practical

- Distance measurement by using chain, Tape, and Perambulator.
- Chain surveying
- Compass traversing by using prismatic and survey or compass
- Direct and indirect ranging
- Measurement of Included Angles by Prismatic Compass in a close traverse.
- Height of a tree/building by using Abney hand level
- Kibla direction by using prismatic compass
- Plan table surveying by radiation and traversing methods
- Temporary adjustment of level in the field
- Leveling by Height of Instrument methods
- Leveling by rise and fall method
- Profile leveling by using engineers level
- Topographic surveying and contour drawing
- Use of Theodolite in the field and to measure horizontal and vertical angles
- To calculate area of a map by using planimeter
- Use of Tachometric to measure distance.

Books Recommended

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

Engineering Statics

3(2-2)

Basic concept, types of forces, composition and resolution of forces, movement of a force, transformation of a couple, resultant of force systems: resultant of coplanar and concurrent forces, resultant of non-coplanar and concurrent and non concurrent forces, resultant of non-coplanar and non-concurrent forces.

Equilibrium of force systems: Free body diagrams, equations of equilibrium for concurrent and non-concurrent force systems, equilibrium of planar systems, equilibrium of spatial systems.

Analysis of trusses: Types of trusses.

Analysis of forces by the method of joints and method of sections.

Centre of gravity: Centre of gravity of rigid bodies (3 co-ordinate system) centroids of weights, lines, areas and volumes, centroids of composite areas, theorems of pappus. Centre of gravity of composite masses.

Friction: Theory of friction, square threaded screws, belt friction and transmission of power.

Practical

To verify the law of polygon of forces, the law of arallelogram of forces, the principles o moments, the co-efficient of friction between surfaces. Special numerical problems and assignments

Books Recommended

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

Fluid Mechanics

3(2-2)

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

Practical

- Viscosity of a given fluid by viscometer
- Metacenter and center of buoyancy.
- Drag on a small sphere.
- Bernoulli's Theorem.
- Flow through venturimeter.
- Velocity with pitot tube.
- Flow through a pipe orifice meter
- Co-efficient of discharge for a rectangular and triangular weir.

Books Recommended

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

Metallurgy and Workshop Practices

3(2-2)

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

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

Non-ferrous metals: Properties and uses of copper, aluminium, zinc, tin, nickel, and lead. Non-ferrous alloys, copper alloys. Aluminium alloys, zinc base alloys, nickel base alloys. Lead-tin alloys, iron-carbon equilibrium diagram

Heat treatment: Heat treatment theory and process, heat treatment of steel, annealing, hardening, tempering, normalizing, surface hardening, quenching, heat treatment equipment.

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

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

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

Practical

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

Books Recommended

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

Applied Mathematics

3(3 – 0)

Introduction to Complex Numbers: Definition, Demoviers theorem and its application, hyperbolic, inverse hyperbolic and other functions.

Derivates: Ordinary derivatives, general theorems, derivatives of functions, practical derivatives, geometrics meaning and practical derivatives of higher order.

Anti-derivatives: Indefinite integration by substitution and by parts and by reduction formula.

Definite integration: Various functions, double & triple integral, application of definite integrals, area under a curve, length of an arc, center of gravity, volume of solids of revolution and moment of inertia.

Books Recommended

1. Yousaf, S.M. and M. Amin.1985. Calculus with Analytical Geometry
2. Thomes, B. G. 1987. Calculus & Analytical Geometry.

Basic Agriculture

3(2 – 2)

Agriculture history, importance and branches, salient features of Pakistan's agriculture, classification of field crops, crops in relation to climatic conditions, ecological zones of Pakistan, soil types and their role in crop production, cropping pattern and system, cropping intensity, role of fertilizers, manures, green manuring, crop rotation, organic matter, soil fertility and productivity.

Classification of crops, modern production techniques to grow major crops; cereal, fiber and oil seeds crops, pulses, fodders, vegetables, climate, pure seed, time of sowing, seed rate, irrigations, fertilizer & bio fertilizer requirements, weed control, insect pest control, diseases and of major crops, harvesting and post harvest care.

Practicals:

- Identification of various crops.
- Study of different soil types.
- Identification of seeds of various crops.
- Classification and identification of various commercial fertilizers and manures.
- Study of common hand tools and indigenous machines used in farming.
- Measurement of area of a piece of land using Gunter and Engineer chain.

Books Recommended

1. Shafi Nazir 1994. Crop Production. National Book Foundation, Islamabad, Pakistan.
2. Martan, 1990. Principles of Field Crop Production, McMillan Co. Inc. New York.

2ND SEMESTER

Engineering Materials

2(2-0)

Stone: Stone and its hardness, uses, classification characteristics of good building stone, important building stones, examination and testing of stone.

Clay and clay products: Brick earths and bricks, harmful constituents of brick clays. Preparation and burning of bricks, tests and characteristic of good bricks, tiles and terra cotta.

Lime and Mortars: Lime and its handling precaution, lime classification and uses. Mortars, type of mortars, object of mixing sand in mortars and concrete, test for mortars, precautions in the use of mortar, grout, gypsum and plaster of Paris.

Cement; Different varieties of cement, manufacture of cement, dry and wet process practical test of cement

Aggregates: fine and coarse aggregates, harmful materials, functions of surkhi and sand in mortars.

Concrete: Lime concrete, cement concrete, water cement ratio, proportioning of concrete mixes, curing of concrete, placing and compaction of concrete, qualities of good concrete.

Timber: Definition, classification of trees, growth of timber trees and its structure, characteristics of hard wood and soft wood, characteristics of good timber, defects in timber, felling, sawing and seasoning of timber, characteristics and uses of common trees, measurements.

Plastics: properties of plastics, manufacture of commercial plastic goods to be used in building construction.

Tar, Bitumen and Asphalt: General tar, road tar, crude and coal tar pitch, bitumen, asphalt, tests for tar and bitumen.

Books Recommended:

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

Mechanics of Materials

3(2-2)

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

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

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

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

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

Deflection of beams: Double integration method with singularity function, area moment method,

Torsion: Shearing stress and angle of twist, hollow and circular shafts.

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

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

Practical

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

Books Recommended

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

Hydraulic Machinery

3(2-2)

Introduction: Definition, types and uses of hydraulic machinery.

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

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

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

Hydraulic turbines: Definition, types of turbines, suitability of turbines, components of turbines, inlet and outlet velocity diagrams, guide blade angle, inlet and outlet vane angles WHP and BHP of turbine, hydraulic, mechanical and overall efficiency of turbines, factors influencing the performance of turbines.

Practical

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

Books Recommended

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

Manufacturing Engineering

3(2-2)

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.

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

Engineering Thermodynamics

4(3-2)

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

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

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

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

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

Compound expansion: advantages of compound expansion, tandem type of two-cylinder compound engine, receiver type compound engine; combined

indicator diagram for compound engine, Calculations for cylinder uniflow engine.

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

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

Practicals

- 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

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

Soil Science

3(2 – 2)

Introduction: Origin and nature of Soil, soil structure, soil texture, physical and mechanical properties of soil, major soil constituents; sand, silt and clay, soil classification

Colloidal Complex of Soil: Structure and properties of silicate clays; Exchangeable Bases and Cation Exchange in soil, soil reactions

Soil Water: Soil moisture content, unsaturated flow, measuring soil moisture, solute movement in water and soil.

Study of Salt Affected Soil : pH value of Soil and its significance, salinity and sodicity, classification, reclamation and management, quality of irrigation water and its effect on soil properties, methods of reclamation and management of saline and water-logged soils.

Soil Fertility: Types of plant nutrients, fertilizer elements, Nitrogen, Phosphorous and Potassium (NPK) fertilizers, soil solution, nutrient uptake by plant.

Practicals

- Mechanical analysis of soil type by sieve and pipette method.
- Measurement of bulk density and porosity of soil
- Estimation of infiltration rate of saline and water-logged soils
- Study of moisture characteristic curves using pressure plate.
- Measurement of soil pH, CEC, SAR, and ESP
- Determination of quality of irrigation water.

Books Recommended

1. Brady, N. C. 1992. The nature and properties of soils, 8th edition, McMillan Company, Ltd. USA.
2. Tanji, K.K. 1990. Agricultural salinity assessment and management. ASCE No.71, New York, USA.
3. Gupta, I.C. 1990. Use of saline water in Agriculture. Oxford and IBH Pub. Co., New Delhi, India.

Applied Physics

3(2 – 2)

Electricity and Magnetism: Voltage, current, resistance, power, single phase and 3 phase A.C. supply. Series and parallel circuits. Vector addition and subtraction of A.C. voltages.

A.C/D.C. motors: Concept of rotating fields, polyphase induction motor, lap and wave winding of single phase and three phase motors, torque and starting characteristics, measuring instruments, transformers. A.C power

generators. Electrical distribution and wiring for farm buildings. Electric controls, motor controls, and protection. Selection of farm motors, applications of electricity at farm.

Electronics: Semi-conductors, PN-junction; Transistor; its characteristics and uses; Amplifiers; Power supplies; Magnetism: Electro-Magnetic induction and radiation; Radioactivity: Radio isotopes; Biological effects of radiation; Laser: Introduction, generation and uses of Laser. Fiber optics – characteristics.

Practical

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

Books Recommended

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

3RD SEMESTER

Computer Aided Drawing

2(1-2)

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

Practical

Drawing and working problems on AutoCAD Mechanical Power Pack Package

Books Recommended

1. Autocad 2004. Autocad Mechanical Power Pack, Autodesk Newyork, USA.
2. French, T.E. and Vierch, C.J. 2000. A Manual of Engineering Drawing, McGraw Hill Book Company. New York.
3. Ravi. B. 2005. Metal Costing Computer Aided Design and Analysis.
4. Ralph G. 2005. The Illustrated Auto CAD-2005. Quick Reference.
5. Dix.M. and Paul R. 2002. Discovering Auto CAD
6. Sham, T. 2005. AutoCAD-2005. A problem Solving Approach.

Engineering Dynamics

3(2-2)

Absolute Motion: Rectilinear, Angular and Curvilinear motions, motion of projectiles and rigid bodies.

Relative Motion: Relative displacement, velocity and acceleration, instantaneous centers. Force and Energy.

Translation of a rigid body, Rotation of rigid body. Work and energy: Work done by system of forces, potential and kinetic energy of practical principle of work and kinetic energy, conservation of energy, power and efficiency.

Impulse and Momentum: Principle of linear impulse and momentum, principle of angular impulse and momentum, conservation of linear and angular momentum.

Practical

Moment of inertia of fly wheel mounted on wall and a wooden block by biffler suspension. Efficiency of various models of machines. Modulus of rigidity of metal bar by static and dynamic methods. Special numerical problems and assignments.

Books Recommended

1. Riley, W.F. and Sturges, C.D. 1996. Energy Mechanics , Statics and Dynamics, John Wiley & Sons. Inc. New York.
2. Meriam, J.L. and L.G. Kraige. 2001. Engineering Mechanics. Vol.II Dynamics. John Willy and Sons, New York.
3. Singer, F.L. 2000. Engineering Mechanics. Harper and Row Publishers, New York.
4. Higdon, A. and W.B. Stile. 1986. Statics and Dynamics. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.
5. McGill, D.J. and King, W.W. 1994. Engineering Mechanics: Statistics and Dynamics, PWS Publishing Co. New York.
6. Bed Ford, A. and Fowler, W. 1994. Engineering Mechanics: Statistics: Statistics & Dynamics, Addison-Wesley Publishing Company, New York.

Surface Water Hydrology

3(2-2)

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

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

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

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

Practical

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

Books Recommended

1. Awan, N.M. 1981. Surface Water Hydrology, National Book Foundation, Islamabad.
2. Linsely, R.K., Kohler, J.L.H. Paulhyus 1996. Hydrology for Engineers, SI.

Edition, McGraw Hill Kogakusha Ltd.

3. Ward, R.C., Robinson, M. 1990. Principles of Hydrology, McGraw Hill Book Co., London.
4. Wilson, E. M. 1990. Engineering Hydrology, Macmillan Civil engineering hydraulics.N.Y.

Soil Mechanics

3(2-2)

Introduction: Definition and objectives of soil mechanics, importance of soil mechanics in irrigation and drainage.

Physical soil properties: Texture, structure, soil phases, porosity, void ratio, water content, degree of saturation, soil density, unit weight, specific gravity and their determination. Temperature correction factor, Integral or cumulative curves, volumetric and gravimetric relationships. Functional relationship between various soil properties.

Soil consistency: Definition, plasticity, liquid limit, plastic limit, shrinkage limit, states of consistency, plasticity ratio, and degree of shrinkage, relationship between shrinkage limit, shrinkage ratio and specific gravity.

Soil compaction: Definition and purpose of compaction. Compaction test of soil. Moisture content. Dry density relationship, saturation line. Derivation of dry density equations and their application. Needle penetration test. Relative dry density.

Consolidation: Definition of terms, importance of consolidation in structures and settlement, causes of settlement and effects of settlement on structures. Methods of reducing settlement, Consolidometer, consolidation test, stress-strain relation in consolidation process.

Shear Strength of Soil: Definition, influencing factors on shear strength of soil, types of shear test, shear strength of sand and clay, tri-axial compression – mohr's circle, use of tri-axial test.

Practical

- Soil moisture contents by different methods.
- Determination of bulk density by sand replacement and sampling tube.
- Determination of specific gravity of soil.
- Determination of liquid limit, plastic limit, and plasticity index and shrinkage limit of soil.
- Grain size analysis of given soil sample by Sieve Analysis, hydrometer and pipette methods.
- Modified proctor compaction test.

Books Recommended

1. Jumikis, A.R. 1994. Soil Mechanics, D. Van Nostrand Company Inc.,

- Princeton, New Jersey.
2. Terzaghi, K. 1997. Soil Mechanics in Engineering Practice. John Wiley & Sons, New York.
 3. Mckeyes, E. 1989. Agricultural Engineering Soil Mechanics. Elsevere New York.
 4. Smith, G.N. 1990. Elements of Soil Mechanics. BSP Professional Books, Oxford.

Instrumentation and Mechatronics

3(2-2)

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

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

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

Force and Torque Measurements: Force Measurements; Load cells. Torque measurements; torque cells.

Pressure Measurement: Gauge, vacuum and absolute pressure, pressure measuring devices.

Measurement of Temperature: Resistance thermometers, thermocouples and radiation methods.

Fundamentals of mechatronics: Introduction to electronics and sensors used in agricultural machinery, interfacing the machine and computers for response, controls and data logging, computer simulation of mechanical system.

Practical

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

Books Recommended

1. Neculescu, D. S. 2002. Mechatronics, Prentice Hall Inc., N.J., USA.
2. Figliola, R. S. and D. E. Beasley. 3rd ed. 2004. Theory and design for Mechanical measurements. John Willey & Sons (Asia) Pte, Inc. Singapore
3. Dally, J. W. W. F. Riley and K. G. McConnel. 2003. Instrumentation for engineering measurements, 2nd ed. John Willey and Sons, Inc. Singapore
4. Shetty, D. and R. A. Kolk. 2001. Mechatronics system design. Vikas Publishing House,Pvt, Ltd. New Delhi, India
5. Mahalik, N. P. 2003. Mechatronics, principles, concepts and applications. Tata McGraw Hill, New Delhi, India

Advanced Mathematics for Engineers

3(3 – 0)

Vectors & Scales: Inverse of vectors, equality of vectors, collinear vectors, addition of vectors, directional cosines, scalar and vector products, vector triple products.

Matrices and determinants, kinds, addition, multiplication and rank of matrices, solution of system of linear simultaneous equation. Determinants, properties, minors, cofactors & Laplace expansion, crammers rule and some matrix applications.

Differential equations: Ordinary, higher order linear and partial differential equation and their application in engineering.

Laplace transform: Laplace transform of some elementary functions, Laplace transform theorem. Inverse Laplace transforms and methods of their finding. Application to solution of ordinary differential equations. In definite series and fourier series.

Books Recommended

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

Industrial Chemistry

3(2 – 2)

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 hydrogenation of oils, sugar industry and its by-products, nitrogenous, phosphatic and potassic fertilizers. Aerobic & non aerobic fermentation.

Practicals

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

Books Recommended

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

4TH SEMESTER

Theory & Design of Structures

2(2-0)

Soil bearing properties of soils and design of foundation. Theory and design of reinforced concrete beams, slabs and columns.

Analysis of Indeterminate structures by the application of the methods of three moments, slope deflection, column analogy and conjugate beam.

Advanced problems for the determination of slope and deflection by the application of Castigliano's theorem.

Design problems and special numerical exercises.

Books Recommended

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

Environmental Engineering

2(1-2)

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

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

Water Pollution: Sources of pollution and types, agricultural practices and water pollution, Solute transport phenomenon, Wise 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: Concept of sound *Waste and Its Management,* Industrial hazardous waste, hospital waste management, radioactive waste management

Practical

- Measurements of pH, colour, odour, BOD, COD, solids, nitrate of water and waste water etc.
- Measurement of dust and fume in the air.
- Measurement of noise level.

- Case studies exercises and assignments.
- Design of Green House and Plant Environment Control System.
- Total coliform test in drinking water by multiple fermentation tube method.

Books Recommended

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

Soil Dynamics

3(2-2)

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

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

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

Practical

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

Books Recommended

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

Open Channel Hydraulics

3(2-2)

Basic concepts of Fluid Flow: Types, states and regimes of flow, channel 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 equation, specific energy, critical depth, alternate depths, E-Y relationship, criteria for a critical state of flow, computation of critical flow, flow control, application of flow control in rectangular channel, momentum in open channel flow, specific momentum, hydraulic jump, conjugate depth, 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, best hydraulic section, determination of sections dimensions.

Steady and Unsteady Flow: Introduction to steady and unsteady flow. Characteristics of steady and unsteady flow.

Varied Flow: Characteristics of varied flow The sharp-crested weir, aeration of the Nappe, crest shape and discharge over spillways, type and characteristics of the hydraulic jump, location of jump, jump as energy dissipater, flow through sudden transitions, flow over a hump.

Practical

- Determination of discharge by flumes.
- Energy consideration in open channel flow: Y-Q relationship.
- Confirmation of theory relating to the flow of water over a hump: E-Y relationship.

- Determination of Chezy c and Manning's n for a rectangular glass channel.
- Plotting flow profile of an open channel flow.
- Laboratory study of hydraulic jump and alternate depth.

Books Recommended.

1. French. R.H. 1996. Open Channel Hydraulics. McGraw-Hill International Book Company
2. Henderson, F.M. 1990. Open Channel Flow. Macmillian Publishing Co., Inc.
3. Chow, V.T. 1973. Open Channel Hydraulics. Mc. Graw-Hill International Book Company.
4. Chadwick, A., Mortelt, 1993. Hydraulics in Civil and Environmental Engineering E & FN Spon, London.

Boiler Engineering and Power Plants

3(2-2)

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

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

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

Practical

- Demonstration and inspection of different types of boilers.
- Determination of calorific value of fuel
- Analysis of flue gases using gas analyzer

- Quality analysis of steam
- Measurement of impulse force on vane of turbine
- Assessment of power generation at output shaft
- Visit to different power plants
- Visit to sugar and textile industries to study boilers and steam power.
- Visit to nuclear and steam power plants.

Books Recommended

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

Processes Engineering

3(2-2)

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, psychrometric 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 Psychrometric chart to calculate heat transfer during aeration/drying.
- Study of dehydration characteristics of fruits/vegetable by moisture content vs time curve and drying rate vs moisture content curve.
- Visit to cold storage facilities.
- Study tour to visit agricultural processing units and plants.

Books Recommended

1. Pandey, H. H. K. Sharma, R. C. Chauhan, B. C. Sarkar and M. B. Bera. 2004. Experiments in food process engineering. CBS Publishers and distributors, New Delhi, India
2. Sahay, K. M. and K. K. Singh. 2002. Unit operation of agricultural processing. 2nd ed. Vikas Publishing House, New Delhi, India.
3. Henderson, S.M. 1986. Agricultural Process Engineering. The AVI Publishing Company, Inc. Westport, Connecticut. USA.
4. Hanlon, J. F. 1992. Handbook of packaging engineering. 2nd ed. John Willey and Sons, N.Y., USA
5. Myler, H. R. 1999. Fundamentals of machine vision. Prentice Hall of India, New Delhi.

Computer Programming and Applications

3(2 – 2)

Introduction: Computer components, computer operating system, computer softwares & applications, use of internet and E-Mail.

Programming: Introduction, programming languages, flowchart, programming structure, introduction to C++, application of C++ to solve engineering problems.

Practical

- Demonstration of computer components and operating system.
- Exercise on the use of word processing, spreadsheet and engineering graphics.
- Programming of engineering problems with C++.

Books Recommended:

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

Technical Writing

2(2 – 0)

English grammar (TOEFL oriented) and technical report writing concepts. Essay writing, comprehension (Current English Passage), letter (Official/Private) and application writing, close test (Insertion of appropriate words in the paragraph meaningfully).

Books Recommended

1. Khan, Nosheen & Qureshi, G.S. 1997. A Selection of English Prose. The Caravan Book House, Katchery Road, Lahore.
2. W. Stannard Allen. 1978. The Living English Structure. Khurram Publishing Enterprises, Lahore, Pakistan
3. Hill, L.A. and R.D.S. Fielden. 1997. Further Comprehension and Precis, Pieces for Overseas Students (Latest edition). The Book House, Publishers and Booksellers, Lahore, Pakistan

5TH SEMESTER

Ground Water Hydrology

3(2-2)

Groundwater resources of Pakistan: Total potential, its contribution to irrigation water, domestic and industrial use

Basic concepts: Concepts of groundwater and soil, types of subsurface water, water potential, aquifer, aquiclude, soil water movement and groundwater movement, aquifer functions, porosity, storage coefficient, hydraulic conductivity, transmissivity, hydrologic cycle.

Groundwater movement: Darcy's law and its applications, observation wells, piezometers, flow nets, streamlines, equipotential lines, steady state flow, non steady flow.

Well hydraulics: Steady state flow in confined and aquifers, steady flow in unconfined aquifer with uniform recharge, unsteady flow in unconfined aquifer, steady state aquifer test, multiple well system. Groundwater extraction techniques.

Practical

- Measurements of water level below soil by electric sounding.
- Determination of groundwater flow rates and direction.
- Determination of hydraulic conductivity using different methods.
- Determination of draw down and well efficiency.
- Use of groundwater flow model.

Books Recommended

1. Driscoll, F.G. 1987. Groundwater and Wells, Johnsen Division, St. Paul, Minnesota, USA.
2. Ahmad, N. 1985. Groundwater Resources of Pakistan, Shazad Nazir Publisher, Gulberg-III, Lahore.
3. Bouwer, H. 1996. Groundwater hydrology. McGraw Hill Inc. New York.
4. Ranghunath, H.M. 1987. Groundwater, Willy Eastern Ltd., Singapore.
5. Schwartz, F.W. and Zang, H. 2003. Fundamentals of Groundwater. John Wiley and Sons, New York.
6. Mcwharter and Sunada, 1987. Groundwater Hydrology.

Introduction: Land and water resources of Pakistan, soil and water conservation problems and its importance, soil and water conservation practices in Pakistan.

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

Rainfall and Runoff Relationship: Factors affecting runoff, rainfall characteristics related to erosion. Analysis of precipitation data and effective precipitation.

Water Erosion and Control Practices: Factors affecting erosion by water, types of water erosion, mechanics of erosion, forms of water erosion, universal soil loss equation and its components, soil loss estimation and erosion control practices.

Wind Erosion and Control Practices: The mechanics of detachment, transport and deposition of soil particles, estimation of soil loss by wind erosion and control practices.

Conservation Techniques: Terracing; Functions, classifications, design, location and maintenance. Contour farming; Water Harvesting; Principles and techniques, short and long term methods.

Vegetated Waterways: Use, design and maintenance of vegetated waterways.

Conservation Structures: Functional requirements of structures, limitations and design of drop spillways, culverts and pipe spillways.

Watershed: Definition, watershed characteristics, importance of watershed management in water resources.

Embankments and Farm Ponds: Types, foundation requirements and design of earth embankments, mechanical spillways, flood or emergency spillways, types, requirements, site selection and design of farm ponds.

Practical

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

Books Recommended

1. Suresh, R. 2000. Soil and Water Conservation Engineering. Standard publishers Distributors, 1705-B Nai Sarak, Delhi, India.
2. Schwab, G. O., Fervert, R.K., Edminster, T.W. and Baren. K.K. 1993. Soil and Water Conservation Engineering, John Wiley & Sons, New York.
3. Kirkby, M.J. 1980. Soil Erosion. John Willey & Sons, New York.
4. Linsely, R.K. and Franzini, Joseph. 1996. Water Resources Engineering. McGraw Hill. FAO.
5. Dastane, N. G. 1979. Effective Rainfall. FAO, Irrigation and Drainage Paper 25, Rome, Italy.

6. Hudson, N. 1976. Soil conservation, BT Batsford Ltd. Morga RPC.
7. Schwab G. O., D.D. Fangmeier. W.J. Elloit and R.K. Frevert. 1992. Soil and Water Conservation Engineering. 4th Edition. John Wiley and Sons, New York.
8. Frederick, R.T. and J. A. Hobbs. 1991. Soil and Water Conservation. Prentice Hall, Englewood Cliffs, New Jersey, USA.

Water Quality Management

2(1-0)

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.

Practicals

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

Books Recommended

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

Energy Resources and Management

3(2-2)

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

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

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

Wind energy: Wind energy potential in the country. Application of wind energy (domestic / agriculture). Importance of vertical and horizontal axis for wind mills, wind operated pumps for water lifting.

Practical

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

Books Recommended

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

I.C. Engines and Tractors

3(2-2)

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

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

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

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

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

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

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

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

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

Practical

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

Books Recommended

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

Farm Machinery

3(2-2)

Introduction and objectives of farm machinery: Implement types, mechanical and hydraulic power transmission.

Implement hitching, traction, and testing: Principles of hitching, types of hitches, control of hitches; tyre types, soil compaction; traction aids.

Soil Tillage: objectives, types of tillage, tillage implements, adjustments of implements tillage implements, mechanics of tillage tools, performance of tillage tools.

Crop Planting: Introduction; methods and equipment, functional processes; evaluating seed drill and planter performance, metering mechanisms.

Chemical and fertilizer application: Introduction; methods, distributors, broadcasters, liquid chemicals application, performance evaluation of chemical application equipment; types of sprayers, selection of sprayers, sprayer calibrations.

Harvesting:- Introduction, time and moisture contents at the time of harvesting for wheat and rice. Adjustments and applications of various harvesting machine.

Practicals

- Introduction to farm machinery.
- Review of different systems of a farm tractor.
- Hitching & de-hitching practice of implements behind.
- Performance evaluation of a mould-board plow, disk-plow, cultivator and off-set disk-harrow.
- Calculation of pulverization index of selected tillage implement
- Performance evaluation of a field cultivator
- Calibration of a seed drill/planter
- Visit to Agri. Engg. Workshops
- Operation and maintenance of harvesting machines.

Books Recommended

1. Kepner, R. A., R. Bainer, and E.L. Barger. 2000 Principles of Farm Machinery, John Willey and sons, N.Y.
2. Hunt, D. 2003. Farm Power and Machinery Management. Iowa State University Press, Ames, Iowa, USA.
3. Suresh, R. and S. Kumar. 2004. Farm power and machinery engineering. Standard Publishers, New Delhi, India.
4. Srivastava, A.K., C.E. Goering, and R.P. Rohrbach. 1993. Engineering Principles of Agricultural Machines. ASAE Text Book No. 6.

Islamic Studies

2(2 – 0)

As per HEC policy

Pakistan Studies

2(2 – 0)

As per HEC policy

6TH SEMESTER

Environmental Management System in Industry

3(3-0)

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

Books Recommended

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

Irrigation Engineering

3(2-2)

Introduction: Definition of irrigation, need for irrigation, sources of irrigation water, (surface water, groundwater and rainfall), utilization of water for agricultural purposes.

Indus Basin Irrigation System: Components, operation and maintenance of Indus basin irrigation system, conveyance and distribution of irrigation water.

Irrigation Structures: Dams, barrages, headworks, diversion structures, types and functions of outlets, desirable features/characteristics of outlets, design and construction of outlets, water measurement structures, energy dissipater, transition and erosion protection.

Canal Design and Maintenance: Layout of canals, design of canals, Kennedy's and Lacy's theories, silt factor and friction factors, canal lining and its advantages, maintenance of canals.

Water Losses: Water losses in canals and watercourses, measurement of water losses and methods to alleviate water losses.

Sediments Transport: Types of sediments in irrigation water, sampling and measurements of sediments, sampling equipment, effect of sediments on flow regimes and field topography, methods to check sedimentation.

Discharge Gauging: Methods of measuring flow in canals, depth-discharge relationships, water measuring devices and structures.

Flood Protection: Importance of floods in irrigation system operation, types of floods, damages caused by floods, methods of flood control and cost of flood protection.

Practical

- Study of characteristics of various irrigation structures in Punjab.
- 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.

Books Recommended

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

Pumps and Tubewells

3(2-2)

Introduction: Functions of pumps and tubewells, importance of pumps and tubewells in irrigation and drainage, groundwater exploitation by tubewells.

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

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

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

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

Practical

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

Books Recommended

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

Computational Engineering

3(2-2)

Information Technology: Introduction, information system and information technology, Impact of information technology, data and information, data types, role of computer in information technology, types of computers, computer architecture; coding, imputing, storing, retrieving and displaying data, operating system software, types of computer networks and their role in information technology.

Engineering Graphics: Introduction, introduction to computer graphics, ingredients of computer graphics, data presentation with engineering graphics, grading and digitizing data, engineering graphics software and their use in creating two and three-dimensional graphs.

Geographic Information System (GIS): Introduction, types of GIS data, sources, maps and geographic coordinates, use of GIS in mapping spatial variability in the soil physical properties of tilled and untilled soil, Global Positioning System (GPS), GIS applications – precision farming

Practical

1. Demonstration of computer hardware and software.
2. Demonstration of Local and Wide area computer networks.
3. Use of different Engineering Graphics software to draw contours, surfaces and three-dimensional graphs..
4. Demonstration of GIS package.
5. Demonstration of GPS to locate point, line and area features.
6. Visit to organizations using GIS
7. Student projects.

Books Recommended

1. Rajaraman, V. 2003. Introduction to information technology. Prentice Hall of India, Pvt, Ltd. New Delhi, India.
2. Chang, K. T. 2003. Introduction to Geographic Information Systems 2nd ed. McGraw Hill Inc. N. Y.
3. Kraak, M. J. and F. Ormeling. 2004. Cartography: visualization of geospatial data. Pearson Education Pvt. Ltd., Singapore.
4. Sinha. P. K. 2003. Computer fundamentals. BPB Publishers, New Delhi, India.

Farm Power

3(2-2)

General sources of power: Animate and in-animate, tractor history and development. Power transmission system: Clutch and its function, principle of operation, working of single and multiple disk clutch, clutch adjustment, inspection and repair, gear types, gear train, gear box repair, PTO/DTO shafts

Differential and Final Drives: Function, principle of operation, crown gear, pinions, differential lock, differential service, final drive gears.

Hydraulic system: Principles and working of hydraulic system, components of hydraulic system, types, implement control, hitching of implements, repair and maintenance of hydraulic system.

Traction: Traction model, weight transfer, centre of gravity, chassis, mechanics, size and ply rating, tyre service and maintenance, ballasting, track width and, tractor clearance adjustments.

Repair and Maintenance of tractor: need of repair and maintenance schedule, trouble shooting of tractor faults, optimum use of farm power.

Practical

1. Measurement of BHP and drawbar power.
2. Study of hydraulic controls (draft and position)

3. Measuring power of PTO shaft and pulley.
4. Measurement of tractor tyre-slippage with different implements.
5. Measurement of tractor weight transfer under different hitching mechanisms
6. Computation of rolling resistance under different soil conditions.
7. Demonstration of track and clearance adjustments.
8. Study tour to tractor industries/workshop.

Books Recommended

1. Liljedahl, J.B. et al., 1994. Tractors and Their Power Units. John Wiley and Sons, New York.
2. S.C. Jain and C.R. Rai. 1992. Farm Tractor: Maintenance and Repair, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Promersberger and Bishop. 1992. Modern Farm Power. Prentice Hall Inc. Englewood Clifs, N. J., USA
4. Jones, F.R. 1993. Farm Gas Engines and Tractors. McGraw Hill Book Co. Inc. New York.
5. Hunt, H. 2003. Farm power and machinery management. Iowa States, Ames, Iowa, USA.

Machine Design

3(2-2)

Introduction: Mechanical engineering design, design types and requirements, stress formulas and diagrams, factor of safety, materials, failures-theories, variable load and stress concentration, engineering properties of materials, materials specification and selection, velocity and acceleration diagrams, balancing of revolving masses.

Flexible power transmitting elements: Flat and V-belts, design consideration, belt slip and creep, velocity ratio, length of belt and power transmitted by belt, design of belt pulleys, ropes and rope drives, roller chain and drives, flexible shafting, universal joints.

Shaft design: Introduction, bending forces produced by belts and cams, design of shaft for strength, shaft sizes and materials, hollow, round and square shafts, torsional and transverse deflection, vibration and critical speeds of shafts, design of crankshaft and connecting rod, ASME code for shafts.

Clutches, Brakes and Couplings. Positive contact clutches frictional clutches and brakes, friction materials, design of internal expanding and external contracting brakes, rigid and flexible couplings, hydraulic couplings.

Mechanical Springs: spring types (helical and leaf), stresses in springs, spring material, spring selection.

Bolted, riveted and Welded Joints: Stresses in bolted, riveted and welded joints, preloading of bolted joints, stresses in keys, pins and cotters.

Cams: Types of followers and cams, geometry of cams, displacement diagrams and layout of cam curves, forces in cams and followers, strength of cams and followers

Bearings: types of bearings- journal and roller bearings, hydrodynamic lubrication, geometric relations for a journal bearing, bearing loads, design and selection of bearings. *Gears:* Introduction, gear types, synthesis of spur gear, parallel helical gears, worm gears, straight and spiral bevel gears, differentials, gear tooth loads, tooth stress, stress concentration.

Practical

- Sketching free body diagrams of given machine elements.
- Demonstration of axial, shear and torsion loads.
- Determination of modulus of elasticity of a material using universal testing machine
- Determination of modulus of rigidity using torsion testing machine.
- Study of failure of screws fastener and riveted joints.
- Determination of spring constant & end conditions.
- Use of strain gauges for measuring stresses and torque.
- Design of shafts and cams using AutoCAD and computer simulation.

Books Recommended

1. Shigley, J.E. C. R. Mischke and R. G. Budynas. 2004. Mechanical Engineering design. 7th ed. McGraw Hill Co., New York
2. Spotts, M.F. 2003. Design of Machine Elements. Prentice Hall Inc. N.J., USA
3. Faires, W.M. 1996. Design of Machine Elements. The Mc. William Book Co., New York..
4. Cray Krutz. 1994. Design of Agri. Machinery. John Willey and Sons. N.Y.
5. Khurmi R. S. 2004. A text book of machine design, Eurasia Publishing House (Pvt.) Limited 7361 Ramnagar , New Delhi.

Economics for Engineers

3(3 – 0)

General introduction: definition of economics, Significance of economics for engineers. Basic concepts; the theory of production; supply and demand, determination of price, output, revenue and profit under perfect and imperfect competition. Cost comparisons of the use of conventional and modern methods and technologies of farm machinery; Present, Annual and Future worth, replacement analysis, estimation of break even point for farm machinery, estimation of depreciation, cost analysis. Project appraisal and benefit cost analysis, various aspects of project preparation,

analysis and evaluation, identification of costs and benefits of projects and their pricing; Accounting techniques and their application in project evaluation. Project analysis in public and private sectors, some case studies.

ISO 9000 and Quality Management. Elements of ISO 9000, description of 20 elements of ISO 9000, classification of ISO 9000, importance and benefits of ISO 9000, Fundamentals of quality, Quality terminologies, quality management in Pakistan, international quality management.

Books Recommended

1. Samuelson, P.A. 1994. Economics, Introduction Analysis. McGraw Hill, New York.
2. Sinden, J.A. and D.J. Thampalillai. 1995. Introduction to Benefit Cost Analysis, Longmans, Melbourne.
3. Perkins, Frances. 1994. Practical Benefit Cost Analysis; Basic Concepts and Applications. MacMillan, Melbourne.
4. Gittinga, J. Price. 1993. Economics Analysis of Agriculture Products. John Hopkins University Press, N.Y.

Internship

4(0-8)

Students will perform practical work at selected industries/field/sites for full summer session after 6th semester. The marks distribution will be as follows
The internship will carry 80 marks, which will be distributed as; work on the site, data collection and report writing, presentation and oral examination.

7TH SEMESTER

Bio-solids Management

2(2-0)

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

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

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

Books Recommended

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

Principles and Application of Remote Sensing

3(2-2)

Principles of Remote Sensing

Introduction: What is remote sensing? Electromagnetic radiations, Radiation laws, Radiometric terms and units. Type of remote sensing sensors: Spectrometers radiometers, Sensor calibration, Multispectral Scanners, Real and synthetic aperture radars. Platforms and data used in remote sensing: Orbital elements of satellite, Remote sensing satellite, Digital data,

Ground data, Image processing and Interpretation: Image processing systems, Image correction, Resampling, Image enhancement, Spatial filtering, Principal component analysis, classification techniques. GIS and its applications.

Practical

Land use/Land cover, Water quality monitoring, Land degradation, Monitoring of Environmental pollution, Weather analysis and forecasting.

Books Recommended

1. Murai, S. 1997. Remote Sensing Note. Japan Association on Remote Sensing, Tokyo.
2. Foody, G. and Gurrán, P. 1993. Environmental Remote Sensing from Regional to Global Scales. Jhon Willey & Sons, England.
3. Barrett, E.C. and Curtis, L.F. 1992. Introduction to Environmental Remote Sensing. Chapman & Hall, London.
4. Keith, C.C. , Bradley O. Parts and Michael P.C.. 2004. Geographic Information Systems and Environmental Modelling.

Farm Irrigation Systems

3(2 – 2)

Farm irrigation system: Fundamentals, functions, components, types of farm irrigation system such as diversion methods, conveyance methods and application methods. Design of farm irrigation system, data for design, water source evaluation and determination of daily design requirements.

Crop Water Requirements: Evapotranspiration, reference/potential evapotranspiration, crop coefficients, actual evapotranspiration, effective rainfall. Net irrigation requirements, leaching requirements and gross irrigation requirements.

Surface Irrigation Systems: Types and characteristics of different surface irrigation methods (border, basin, furrow), phases of surface irrigation, effectiveness of surface irrigation, design of surface irrigation method, surge irrigation cablegation.

Sub Irrigation: Advantages and disadvantages of sub-irrigation, types of sub-irrigation, use of sub-irrigation in agriculture.

Sprinkler Irrigation Systems: Types of sprinkler irrigation system and their advantages and disadvantages, components of sprinkler systems, design and layout of sprinkler systems, control of micro-climate by sprinkler irrigation.

Drip/Trickle Irrigation System: Advantages and disadvantages of drip irrigation, problems associated with drip irrigation system, components of drip irrigation system, design and layout of drip irrigation system.

Evaluation of Irrigation Systems: Need for irrigation evaluation parameters conveyance, application and distribution efficiencies, coefficient of uniformity, storage and irrigation system efficiency, improvement in irrigation systems' effectiveness.

Practicals

- 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.)
- Preparing irrigation schedule of cropped field.

Books Recommended

1. Cuenca, R.H. 1989. Irrigation System Design – An Engineering Approach. Prentice Hall, Inc., Englewood Cliffs, NJ. 552 pp.
2. Merriam, J. L. and Keller, J. 1978. Farm irrigation system evaluation, A guide for management, Utah State University, 271pp
3. Michael, A.M. 2003, Irrigation, theory and practice, Vikas Publishing House (Pvt), New Delhi, India.
4. Jensen, M. E., 1980. Design and Operation of Farm Irrigation Systems. ASAE Monograph No.3, American Society of Agricultural Engineer, 829pp
5. Walker, W.R. and G. V. Skogerboe, 1987. Surface Irrigation: Theory and Practices. Prentice Hall, Inc., Englewood Cliffs, New Jersey, USA.

Drainage Engineering

3(2 – 2)

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

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

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

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

Practicals

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

Books Recommended

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

Farm Machinery Management

3(2-2)

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

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

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

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

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

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

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

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

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

Practicals

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

Books Recommended

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

Applied Engineering Statistics

3(2 – 2)

Introduction to statistics: graphic representation of statistical data; measures of central tendency and dispersion, introduction to probability; addition and multiplication theorems of probability; the binomial, Poisson's and normal distribution, sampling theory, sampling distribution of means, and the difference between two means, applications of F, t and chi-square distributions; regression analysis; simple, partial and multiple correlation; applications of Analysis of Variance. Computer application of statistics software.

Practicals

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

Books Recommended

1. Muhammad, F. 1999. Statistical Methods and data analysis; Kitab Markaz, Bhowana Bazar, Faisalabad, Pakistan.
2. Ronald E. Walpole. 1982. Introduction to Statistics; McMillan publishing Co., Inc. New York. 10022.
3. Choudhry, S.M. and S. Kamal. 1998. Introduction to Statistical Theory Part I & II; Ilmi Kitab Khana, Kabir Street, Urdu Bazar, Lahore
4. Lester D. Taylor. 1974. Probability and Mathematical Statistics. Harper & Row, Publishers New York.
6. Miller I. and John E. Freund. 1985. Probability and Statistics for Engineers. Prentice Hall, Inc., Englewood Cliffs, New Jersey.

Communication Skills

2(2-0)

Nature of communication, communication in modern organization, team communication, listening, oral presentation, persuasive presentation, conflict resolution, negotiation skills I, negotiation skills II, meetings, Web based communication, debate.

8TH SEMESTER

Farm Structures

3(2-2)

Definition and types of farm service buildings, structural materials and their uses.

Farm stead: Definition, selecting a site for farmstead, developing a farmstead plan, arrangement of farmstead buildings.

Farm buildings design: Planning the farm homes, dairy cattle housing, poultry housing, beef and sheep housing, care and maintenance of farm buildings.

Storage: Characteristics of grains, fiber, fruits and vegetables, and their structural requirements.

Economic aspects of farm buildings and structures, estimating construction costs.

Practical

- *In drafting room:* Drawing layout of farmsteads plans of various types of farm buildings, and working drawing of structures.
- *In material testing laboratory:* Study of building materials such as stone, clay and clay products, lime and mortars, cement, concrete, timber, paints and varnishes and other miscellaneous materials.
- Local field trips to observe existing farm structures and investigating possibilities for improvement.

Books Recommended

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

Water Management Engineering

3(2–2)

Introduction: Concept of water management and its developments in Pakistan, components of water management.

Water distribution: Irrigation system management, warbandi-types, rotation system advantages and disadvantages, constraints of warabandi.

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

Efficiencies: Definition, conveyance, application and storage efficiencies, irrigation efficiency, irrigation system efficiency.

Land Leveling: Importance of land leveling in water management, topographic survey, system layout, determining cuts and fills, land leveling equipment, laser land leveling and use of total station.

Discharge Measurement: Units of measurement, equipment and methods of measurement, interpretation of discharge data, water losses.

Watercourse Design and Maintenance: Hydraulics of open channel flow, flow profiles, design of watercourse for a command, watercourse structures, cleaning and maintenance of watercourses.

Watercourse Construction: Construction requirements and procedure, materials for construction, construction machinery, cost of watercourse lining and improvement.

Lining of Watercourse: Materials of lining, lining techniques, cost estimate of lining

Practicals

- Determination of field capacity and wilting points of a soil sample.
- Land leveling of a given field and cost estimate.
- Field visits of earthen and lined water courses.
- Flow measurement in a watercourse and interpretation of data.

Books Recommended.

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

Design of Agricultural Machinery

3(2-2)

General principles of design and design criteria for farm machinery. Engineering standards and reliability, Materials used in the construction of farm machinery. Transmission of power to various types of farm equipment, power requirements. Design of safety devices and automatic controls. Hitching methods and weight transfer. Hydraulic systems design. Factors affecting soil failure patterns and scouring, Design of pre-sowing, post sowing and harvesting equipment. Physical and economic feasibility of design. Application of AutoCAD to design machine elements.

Practicals:

- Synthesis of machine parts and loads.
- Preparation of design estimates and costs.
- Use of AutoCAD in the design of selected machine parts.
- Performance and evaluation of designed machine elements.
- Student project.

Books Recommended

1. Shigley, J.E. C. R. Mischke and R. G. Budynas. 2004. Mechanical Engineering design. 7th ed. McGraw Hill Co., New York
2. Spotts, M.F. 2003. Design of Machine Elements. Prentice Hall Inc. N.J., USA
3. Cray Krutz. 1994. Design of Agri. Machinery. John Willey and Sons. N.Y.
4. Hunt, D. 2003. Farm Power and Machinery Management. Iowa State University Press, Ames, Iowa, USA
5. Suresh, R. and S. Kumar. 2004. Farm power and machinery engineering. Standard Publishers, New Delhi, India

Post Harvest Engineering

2(2-0)

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

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

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

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

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

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

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

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

Practicals

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

Books Recommended

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

Industrial Engineering and Management

3(2-2)

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

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

Product System control: Inventory control, production control, production planning, quality control, statistical process control charts, sampling plan, total quality management, ,

Industrial Management: Definition of Management; Functions of Management: Personal Management; human resource development, Policy Formulation and decision Making. Materials Purchase and Stores Management. Cost Management. Production Routing, Scheduling and Dispatch Management

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

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

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

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

Practical

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

Books Recommended

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

Project and Report

2(0-4)

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

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

Numerical Analysis

2(2 – 0)

Computer Calculations: Binary arithmetic. representation of numbers in computer, errors in arithmetic operations, errors in computational methods.

Solution of non Linear Equations: Simple iteration, bisection method. Newton's method, method of false position, comparison of these methods.

Finite differences: Difference operators and difference table, finite differences of polynomials, Newton's and Gauss's interpolating techniques for equally spaced data, simple theorems on divided difference, Newton's formulae for unequal intervals, Lagrangian's formula of interpolation, method of least squares, numerical differentiation and integration.

Solution of Linear and Simultaneous Equations: Gauss-elimination method, Jacobi's method, Gauss seidel method, sparse matrices, solution of ordinary differential equations, initial value problems, Euler's and modified Euler's methods, Runge Kutta and Kutta-Merson methods.

Eigen Values and Eigen Vectors: Iterative and transformation methods, Eigen values of tridiagonal matrix.

Solution of Polynomial Equations: Polynomial arithmetic, finding initial approximations and complete solution of polynomial.

Books Recommended

1. Mumtaz, K. 2000. Numerical Methods for Engineering Science and Mathematics, 1st Edition, NWFP, University of Engg. & Tech., Peshawar.
2. Griffith, D.V. and I.M. Smith. Numerical Analysis for Engineers. Blackwell Scientific Publishers, London, UK.
3. Packner, J. 1998. Handbook of Numerical Analysis and Applications. McGraw Hill Book Co., Ltd, N.Y.

SCHEME OF STUDIES FOR M.Sc

Total credit hours for M.Sc would be 36, 26 credit hours for course work and 10 for research. Following courses are suggested for the Post-graduate level in the field of Farm Machinery and Powers, Irrigation and Drainage.

LIST OF POSTGRADUATE COURSES FARM MACHINERY AND POWERS

	<u>Credit Hours</u>
1. Post Harvest Engineering	3(3-0)
2. Advanced Power & Machinery	4(3-2)
3. Tillage and Tractor Dynamics	4(3-2)
4. Grain Preservation and Handling	3(2-2)
5. Instrumentation and Control theory	4(3-2)
6. Operations Research	3(3-2)
7. Mechanical Vibrations	4(3-0)
8. Renewable Energy Development	3(2-2)
9. Farm Machinery & Environment	3(2-2)
10. Computer Modeling of Engineering System	3(2-2)
11. Heat and Mass Transfer	3(2-2)
12. Finite Element Theory	3(3-2)
13. Advanced Machinery Design.	4(3-2)
14. Mechanical Failure Analysis	3(2-2)
15. Physical & Thermal Properties of Biological Materials	3(2-2)

LIST OF COURSES FOR
IRRIGATION AND DRAINAGE

1.	Computational Methods in Water Resources Engineering	3(3-0)
2.	Fluid Dynamics	3(3-0)
3.	Advance Open Channel Hydraulics	4(3-2)
4.	Surface Hydrology	3(2-2)
5.	Stochastic Hydrology	3(3-0)
6.	Groundwater Hydrology	4(3-2)
7.	Groundwater Modeling	4(3-2)
8.	Principal and Design of Hydraulic Structures	3(2-2)
9.	Water logging and Salinity Control	4(3-2)
10.	Planning and Design of Drainage Projects	4(3-2)
11.	Planning and Design of Irrigation Projects	4(3-2)
12.	Design of Irrigation Systems	4(3-2)
13.	Irrigation Scheduling	4(3-2)
14.	Surface Irrigation Modeling	3(3-0)
15.	Advance Soil and Water Conservation Engineering.	3(3-0)
16.	Erosion and Sedimentation Engineering	3(3-0)
17.	System Approach to Water Resources Planning-I	4(3-2)
18.	System Approach to Water Resources Planning-II	4(3-2)
19.	Special Problems	1(1-0)
20.	Seminar	1(1-0)

Note: More courses may be added in both fields as prescribed by the concerned universities according to their requirements.

RECOMMENDATIONS

The National Curriculum Revision Committee for Agricultural Engineering has made the following recommendations for implementation in various universities of Pakistan offering bachelor degree in Agricultural Engineering discipline.

1. Teachers training programme should be chalked-out in CAD/CAM, GIS Mechatronics, Machine vision, Remote Sensing and Communication skills for imparting instructions effectively.
2. Training programme should also be arranged in the field of Irrigation & Drainage in following subjects:
 - i) Sediment Transport
 - ii) River Engineering
 - iii) Design of Hydraulic Structures (Storage, Diversion & Conveyance)
3. An internship programme of 4 credit hours carrying 80 marks has been proposed in the summer semester. Sufficient funds should be provided to carry-out this programme.
4. Industrial linkages should be strengthened to carry-out internship programme effectively.
5. A subject titled “Communication Skills” has been added in the scheme of studies to enhance writing and oratory capabilities of the students. Audio visual aids must be arranged in the universities to achieve this goal.
6. Use of computers in Agricultural Engineering is being encouraged in the revised curriculum. Higher Education Commission must provide sufficient funds to the universities for establishment of computer laboratories.
7. The committee observed that The Pakistan Society of Agricultural Engineers (PSAE) is inactivate for last decade. The forum can play very important role to increase the interaction between industry, universities and research organizations. Therefore, HEC is requested for its reactivation.