AGRICULTURAL ENGINEERING

Major Fields : Farm Power and Equipment

Soil and Water Conservation Engineering

Agricultural Processing and Structures.

Minor Fields : Ph.D. student shall take two minors (9 credits of course work in each) from any of the other fields outside his/her own.

M.Tech. student shall take one minor (9 credits of course work) from any of the other fields outside his/her own.

DESCRIPTION OF COURSES

AGR 016 BASIC AGRICULTURAL ENGINEERING (IL+IP) III

Objective

To acquaint with basic principles of agricultural engineering

Theory

UNIT I

Scope and application of Agricultural Engineering

UNIT II

Farm power, sources and scope of mechanization, use of farm engines, power tillers and tractors on the farm, Agricultural equipment and machines for seed-bed preparation, seeding, intercultural, plant protection, harvesting and threshing.

UNIT III

Soil and water conservation engineering; soil erosion- types; causes and control; soil conservation structures; irrigation wells; irrigation equipment including micro-irrigation.

UNIT IV

Agricultural processing and structures: cleaning, grading, drying, milling, storage structure and materials handling and greenhouses.

Practicals

Classification of farm equipment based on different criteria, calibration of equipment, familiarization with different type of soil erosion and control structures, irrigation and drainage system, post harvest processes and equipment.

Suggested Readings

Michael, A.M. and Ojha, T.P. Principles of Agricultural Engineering Vol 1 and 2.

Kepner et al. 1987. Principles of Farm Machinery. CBS Publishing and Distributors.

Liljedhal et al. Tractor and Their Power Units. John Wiley and Sons.

AE 510/ES 510 SOIL & WATER CONSERVATION ENGINEERING (3L+0P) I

Objective

To acquaint and equip with the process of soil and water conservation design of erosion control structures.

Theory

UNIT I

Concepts of soil and water conservation; relevance of soil and water conservation in agriculture; productivity loss due to soil erosion; moisture stress and moisture excess.

UNIT II

Types of soil erosion; mechanics of water erosion of soil; effect of land preparation and cultivation practices on soil erosion; theories of sediment yield and sediment transport; bed load movement; measurement of sediment yield and sediment transport; effective life of dams and water detention structures; effect of soil erosion on the life of multi-purpose river valley projects; soil erosion loss and fertility; erosion in water conveyance systems.

UNIT III

Design of channel for erosion control; maximum permissible velocity; hill soil erosion; land slides; mechanics of wind erosion; types of wind erosion and soil movement; wind erosion control measures.

UNIT IV

Analysis of hydrologic data including rainfall, evapo-transpiration; watershed characteristics; overland flow; methods of estimation of runoff; peak rate and time distribution of hydrograph; synthetic hydrograph; infiltration process.

UNIT V

Hydrologic evaluation of land treatment; flood routing. erosion control; design of soil conservation structures; farm ponds and temporary storage reservoirs, drop structures; chute spill ways; temporary storage reservoirs; small earth dams.

UNIT VI

Aforestation and associated agronomic practices; the role of river valley projects; soil conservation department, CADA etc. in undertaking soil and water conservation work.

Suggested Readings

Garde, R.J. and Ranga Raju, K.G. 1977. *Mechanics of Sediment Transport and Alluvial Stream Problems*. Willey Eastern.

Gurmel Singh *et al.* 1994. *Manual of Soil and Water Conservation Practices*. Oxford & IBH.

Hudson, N.1971. *Soil Conservation*. B.T. Batsford Ltd.

Murthy, V.V.N. 1998. *Land and Water Management Engineering*. Kalyani.

USDA 1969. *A Manual on Conservation of Soil and Water*. Oxford & IBH.

AE 527 OPERATIONS RESEARCH (3L+0P) I

Objective

To develop scientific skill for solving problems involving integrated systems of man-machine and material.

Theory

UNIT I

Introduction to methods of operations research, formulation of problems and construction of models.

UNIT II

Linear programming, solution to linear programming problems, sensitivity analysis, duality in linear programming.

UNIT III

Network analysis including flow, shortest route, minimal spanning tree, PERT and CPM

UNIT IV

Transportation and assignment problems; sequencing and scheduling, inventory control, replacement models.

UNIT V

Markov chains, dynamic programming

Suggested Readings

Carville LA. 1980. *Selecting Farm Machinery*. Louisiana Cooperative Extn. Service Publication.

Culpin C & Claude S. 1950. *Farm Mechanization; Costs and Methods*. McGraw Hill.

Culpin C & Claude S. 1968. *Profitable Farm Mechanization*. Crosby Lockwood & Sons.

FAO.1984. *Agricultural Engineering in Development: Selection of Mechanization Inputs*. Agricultural Service Bulletin.

Hunt D. 1977. *Farm Power and Machinery Management*. Iowa State University Press.

Waters WK. 1980. *Farm Machinery Management Guide*. Pennsylvania Agric. Extn. Service Spl. Circular No. 1992

AE 528 INSTRUMENTATION IN AGRICULTURAL ENGINEERING (2L+1P) I

Objective

To acquaint and equip with the concept of instrumentation and measuring devices in Agricultural Engineering

Theory

UNIT I

Basic concepts of measuring systems, generalized measuring systems, classification of instruments, performance characteristics, errors and uncertainties.

UNIT II

Stress analysis, different types of transducers, application of electrical strain gauges.

UNIT III

Advanced techniques of measurement of force, torque, power and pressure, fluid flow rates, temperature, calorific value etc.

UNIT IV

Basic signal conditioning and monitoring devices, data acquisition system, data storage and their applications.

Practicals

Identification of components of generalized measuring system, Calibration of instruments, Experiment on LVDT, strain gauge transducer, force, torque, power and pressure, fluid flow rates, temperature, calorific value, vibration measurement , Use of data loggers and data storage devices

Suggested Readings

Ambrosius, E.E. *Mechanical Measurement and Instruments*. The Ronald Press.

Beckwith, T.G. *Mechanical Measurements*. Addison-Wesley.

Doeblin, E.O. *Measurement System - Application and Design*. McGraw Hill.

Ernest O Doebelin. *Measurement Systems - Application and Design*. McGraw Hill.

Holman, P. *Experimental Methods for Engineers*. McGraw Hill.

Nachtigal, C.L. *Instrumentation and Control. Fundamentals and Application*. John Wiley & Sons.

AE 529 SIMULATION MODELLING IN ENGINEERING SYSTEMS (2L) II

Objective

To acquaint and equip with the dimensional analysis, modeling and simulation in engineering systems

Theory

UNIT I

Scope of dimensional analysis and simulation modeling, transformation of units of measurement.

UNIT II

Dimensional homogeneity, Buckingham's Pi theorem, simulation for system modeling, simulation models-formulation and testing.

UNIT III

Simulation modeling as applied to problems of stress analysis, fluid mechanics, and heat transfer.

UNIT IV

Mathematical modeling through ordinary differential equation of first order, second order and partial differential equation.

UNIT V

Application of simulation modeling to problems of agricultural engineering.

Suggested Readings

Langhaar HL. *Dimensional Analysis and Similitude*. McGraw Hill.

Sedov LI. *Similarity and Dimensional Methods in Mechanics*. Mir Publ., Moscow.

AE 530/PHT 530 ENGINEERING PROPERTIES OF BIOLOGICAL MATERIALS. (2L+1P) III

Objective

To acquaint and equip with different techniques of measurement of engineering properties and their importance in the design of processing equipment.

Theory

UNIT I

Biological materials, uniqueness in relation to other materials; physical characteristics viz. dimensions, density, volume, porosity and surface area.

UNIT II

Concept of rheology; rheological equations for stress and strain; visco-elastic characteristics of food materials.

UNIT III

Aerodynamic and hydrodynamic properties; thermal, electrical and optical properties.

UNIT IV

Applications of engineering properties in design and operation of agricultural equipment and systems

Practicals

Experiments for the determination of physical properties like, length, breadth, thickness, surface area, bulk density, porosity, true density, coefficient of friction, angle of repose and colour for various food grains, fruits, vegetables, spices and processed foods, aerodynamic properties like terminal velocity, lift and drag force for food grains, firmness and hardness of grain, fruits and stalk.

Suggested Readings

Mohesenin, N.N. 1980. *Physical Properties of Plant and Animal Materials*. Gordon & Breach Science Publ.

Mohesenin, N.N. 1980. *Thermal Properties of Foods and Agricultural Materials*. Gordon & Breach Science Publ.

Peleg, M. and Bagelay, E.B. 1983. *Physical Properties of Foods*. AVI Publ.

Rao, M.A. and Rizvi, S.S.H. (Eds.). 1986. *Engineering Properties of Foods*. Marcel Dekker.

Ronal Jowitt, Felix Escher, Bengt Hallsrram, Hans F, Th. Meffert, Walter EC Spices, Gilbert Vox. 1983. *Physical Properties of Foods*. 33 Applied Science Publ.

Singhal, O.P. and Samuel, D.V.K. 2003. *Engineering Properties of Biological Materials*. Saroj Prakasan.

AE 531 ENVIRONMENTAL ENGINEERING FOR PLANTS AND ANIMALS (3L+0P) I

Objective

To study environment engineering principles for enhanced productivity and health of plants and animals

Theory

UNIT I

Description of aerial environment near the earth's surface

UNIT II

Transport processes in soil; environmental interactions of biological systems and their physical surroundings emphasizing biological response of animals and plants

UNIT III

Design of efficient environmental control machines and systems to enhance productivity and health

Suggested Readings

Albright, L.D. 1990. *Environmental Control for Animals and Plants*. ASAE Textbooks.

Esmay, M.L. and Dixon, J.E. 1986. *Environmental Control for Agricultural Buildings*. The AVI Corp.

Gaudy, A.F. and Gaudy, E.T. 1988. *Elements of Bioenvironmental Engineering*. Engineering Press.

Moore, F.F. 1994. *Environmental Control Systems: Heating, Cooling, Lighting*. Chapman & Hall.

Threlkeld, J.L. 1970. *Thermal Environmental Engineering*. Prentice Hall.

AE 543/SST 543 SEED PROCESSING (2L+IP) III

Objective

To acquaint and equip with processing of seeds and the design features of the equipment used for their processing.

Theory

UNIT I

Introduction to seed processing; preparing seed for processing.

UNIT II

Seed drying; cleaning and grading; seed treatment; seed handling; weighing and bagging.

UNIT III

Seed storage; construction, layout and installation of seed processing plant.

UNIT IV

Economics of seed processing; management of seed processing plant.

Practicals

Study of various seed processing equipment such as pre-cleaners, scalpers, air screen cleaners, graders, spiral and pneumatic separators, seed treating equipment, and their performance evaluation, design and layout of seed processing plant; effect of drying temperature and duration of seed germination and storability.

Suggested Readings

Gregg *et al.* 1970. *Seed Processing*. NSC.

Henderson S & Perry SM. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publ.

Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

AE 554 ADVANCED FOOD PROCESSING ENGINEERING (2L +1P) III

Objective

To acquaint and equip with different unit operations of food industries and their design features.

Theory

UNIT I

Thermal processing: death rate kinetics, thermal process calculations, methods of sterilization and equipment involved, latest trends in thermal processing. Evaporation: properties of liquids, heat and. mass balance in single effect and multiple effect evaporator, aroma recovery, equipment and applications. Drying: rates, equipment for solid, liquid and semi-solid material and their applications, theories of drying, novel dehydration techniques

UNIT II

Non-thermal processing: microwave, irradiation, ohmic heating, pulsed electric field preservation, hydrostatic pressure technique etc.

UNIT III

Freezing: freezing curves, thermodynamics, freezing time calculations, equipment, freeze drying, principle, equipment. Separation: mechanical filtration, membrane separation, centrifugation, principles, equipment and applications, latest developments in separation and novel separation techniques.

UNIT IV

Extrusion: theory, equipment, applications. distillation and leaching: phase equilibria, multistage calculations, equipment, solvent extraction.

Practicals

Solving problems on single and multiple effect evaporator, distillation, crystallisation, extraction, leaching, membrane separation and mixing, experiments on rotary flash evaporator, humidifiers, reverse osmosis and ultra filtration - design of plate and packed tower, visit to related food industry.

Suggested Readings

Brennan, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.I. 1990. *Food Engineering Operations*. Elsevier.

Coulson, J.M. and Richardson, J.F. 1999. *Chemical Engineering*. VolS. II, IV. The Pergamon Press.

Earle, R.L. 1985. *Unit Operations in Food Processing*. Pergamon Press.

Fellows, P. 1988. *Food Processing Technology: Principle and Practice*. VCH Publ.

Geankoplis J. Christie. 1999. *Transport Process and Unit Operations*. Allyn & Bacon.

Henderson, S. and Perry, S.M. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publ.

McCabe, W.L. and Smith, J.C. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.34

Sahay, K.M. and Singh, K.K. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

Singh, R.P. and Heldman, D.R. 1993. *Introduction to Food Engineering*. Academic Press.

Singh, R.P. 1991. *Fundamentals of Food Process Engineering*. AVI PubL.

AE 555 TESTING AND EVALUATION OF AGRICULTURAL EQUIPMENT (2L+1P) I

Objective

To acquaint and equip with the procedure of testing and performance evaluation of farm power and machinery as per test standards.

Theory

UNIT I

Types of tests, test procedures, national and international codes.

UNIT II

Test equipment, uses and limitations.

UNIT III

Laboratory and field testing of selected agricultural equipment.

UNIT IV

Analysis and interpretation of test data, case studies.

Practicals

Laboratory and field testing of selected farm equipment. Interpretation and reporting of test results.

Suggested Readings

Anonymous. 1983. *RNAM Test Code & Procedures for Farm Machinery*. Technical Series 12.

Barger, E.L, Liljedahl, J.B. and McKibben, E.C. 1967. *Tractors and their Power Units*. Wiley Eastern.

Indian Standard Codes for Agril. Implements. Published by ISI, New Delhi.

Inns, F.M. 1986. *Selection, Testing and Evaluation of Agricultural Machines and Equipment*. FAO Service Bull. No. 115.

Metha, M.L., Verma, S.R., Mishra, S.K. and Sharma, V.K. 1995. *Testing and Evaluation of Agricultural Machinery.* National Agricultural Technology Information Centre, Ludhiana.

Nebraska Tractor Test Code for Testing Tractor, Nebraska, USA.

Smith, D.W., Sims, B.G. and O'Neill, D.H. 2001. *Testing and Evaluation of Agricultural Machinery and Equipment - Principle and Practice*.

FAO Agricultural Services Bull. 110.

AE 556 IRRIGATION ENGINEERING FUNDAMENTALS (2L + 1P) I

Objective

To understand the basics and development of irrigation for design of systems in different soil-crop and climatic conditions for efficient use of water.

UNIT I

Water resources and status, irrigation water availability; irrigation statistics and development, concepts of irrigation; irrigation principles.

UNIT II

Evapotranspiration fundamentals and measurements, estimation of water requirement in different methods of irrigation, water budgeting, principles of irrigation scheduling and water application in relation to soil-plant and climatic parameters, soil water measurements, water infiltration.

UNIT III

Design and installation of different irrigation structures; irrigation pumps, design of systems for direct pumping from flowing streams, small reservoirs, wells and tube wells, linking of reservoir with pressurized irrigation system.

UNIT IV

Canal network, planning and design of water course network; hydraulic design of the canal delivery system; lining of canal, irrigation water demand; design of canal capacities and distribution systems; pressurized irrigation in canal command, concept of equity in water distribution

UNIT V

Irrigation hydraulics, water advance and recession, water use efficiency and irrigation efficiencies; farmers' participation in irrigation water management, durface irrigation operation & evaluation, underground water conveyance systems, water law & water rights.

Practicals

Water distribution network, irrigation structures, lining of canals, soil water content measurement, surface irrigation evaluation, evaluation of drip system, evaluation of sprinkler system.

Suggested Readings

Doneen, D. and Westcot, D.W. 1984. Irrigation Practice and Water Management. FAO, Irrigation and Drainage Paper 1 (Rev.), Rome, 63 pp

Doorenbos, J. and Kassam, A.H. 1979. Yield Response to Water, Irrigation and Drainage Paper 33, FAO, Rome, Italy.

Murty, V.V.N. 1998. Land and Water Management Engineering, Kalyani Publishers, New Delhi.586p.

Michael, A.M. 2007. Irrigation: Theory and Practice. Vikash Publishing House Pvt. Ltd., New Delhi.

Postel, S. 1999. Pillar of Sand. W.W. Norton & Company, New York, N.Y. 313 pp.

Walker, W.R. and Skogerboe, G.V. 1987. Surface irrigation theory and practice. Prentice-Hall, Inc. (ISBN 0-13-877929-5), pp 3-6.

Wu, I-Pai and Gitlin, H.M. 1974. Design of Drip irrigation lines, Tech. Publ. No. 96, Hawaii Agric. Exp., Stat., University of Hawaii.

AE 608/ES 608 RENEWABLE ENERGY CONVERSION SYSTEMS (2L+1P) III

Objective

To equip with engineering concepts on renewable energy conversions and uses.

Theory

UNIT I

Energy cycle of the earth, energy flow and storage, renewable energy sources,

UNIT II

Thermodynamics of energy conversion, conversion systems of solar energy, wind energy, biomass energy, hydraulic energy.

UNIT III

Concepts of hybrid and integrated energy conversion systems.

UNIT IV

Applications and economics of different renewable energy systems in agriculture.

Practicals

Experiments on concepts and processes mentioned in theory.

Suggested Readings

Boyle Godfrey. 1996. *Renewable Energy: Power for Sustainable Future*. Oxford Univ. Press.

Culp, A.W. 1991. *Principles of Energy Conservation*. Tata McGraw Hill.

Duffle, J.A. and Beckman, W.A. 1991. *Solar Engineering of Thermal Processes*. John Wiley.

Garg, H.P. and Prakash, J.1997. *Solar Energy - Fundamental and Application*. Tata McGraw Hill.

Grewal, N.S., Ahluwalia, S., Singh, S. and Singh, G. 1997. *Hand Book of Biogas Technology. Solar Energy Fundamentals and Applications*. TMH New Delhi.

Mittal, K.M. 1985. *Biomass Systems: Principles & Applications*. New Age International.

AE 609 ERGONOMICS AND SAFETY IN AGRICULTURAL OPERATIONS (2L+1P) II

Objective

To deign machines, tools and work environment based on human capabilities and limitations.

Theory

UNIT I
Importance and scope of ergonomics in Indian agriculture; Assessment of occupational health hazards on Indian farms.

UNIT II
Anthropometry and biomechanics.

UNIT III
Work physiology, stress indices and their methods of measurement: mechanical efficiency of work and assessment of work performance; work physiology in various agricultural tasks, and sustainable limits.

UNIT IV
Ergonomics and safety considerations in the tools, equipment, controls and work space; injury concept and prevention methods, injury severity assessment, determination of postural discomfort, Farm safety legislation

UNIT V
Mechanical environment; noise, vibration, dust and illumination and their physiological effects;

Practicals

Assessment of occupational health hazards on Indian farms, measurement of static and dynamic anthropometric dimensions, postural discomfort and overall tiredness level, assessment of tractor layout, ergonomic evaluation of hand tools used on farm, noise exposure assessment, measurement of vibration, assessment of dust concentration in breathing zone of a worker, analysis of an injury using Haddon's Matrix

Suggested Readings

Bridger, R.S. 1995. *Introduction to Ergonomics*. McGraw Hill.

Grand Jean, E. "Human Factors in Engineering Division."Taylor and Francis

Kromer, K.H.E. 2001. *Ergonomics*. Prentice Hall.

Mathews, J. Sanders, Cormicks, M.S. and MCE. 1976. *Human Factors in Engineering and Design*. 4th Ed. McGraw Hill.

Zander J. 1972. *Principles of Ergonomics*. Elsevier.

AE 610 THEORY OF ELASTICITY AND STRESS ANALYSIS (3L+0P) III

Objective

To acquaint and equip students with different techniques/methods of stress analysis and its application in agricultural machine design

Theory

UNIT I

Plane stress-strain relationships, Analysis of stress and strain in three dimensions torsion, bending of bars.

UNIT II

Thermal stresses, stress analysis in agricultural machine design.

UNIT III

Problem solving and case studies.

Suggested Readings

Srinath, L.S.1984. *Experimental Stress Analysis*. Tata McGraw Hill.

Singh, Sadhu. 1982. *Experimental Stress Analysis*. Khanna Publ.

Dally, J.W. and Riley, W.F. 1990. *Experimental Stress Analysis*. Tata McGraw Hill.

AE 614 DYNAMICS OF FARM MACHINERY (2L+1P) I

Objective

To acquaint and equip with dynamic force analysis for farm machinery component designs

Theory

UNIT I

Farm machine systems characteristics and evaluation.

UNIT II

Analysis of forces, motion and their equilibrium in the elements of farm machines.

UNIT III

Dynamic balancing and stability of farm machines, analysis of typical problems in tractor implement systems.

UNIT IV

Research reviews on design and analysis of farm machines and components.

Suggested Readings

Barger, E.L., Liljedahl, J.B. and McKibben, E.C. 1967. *Tractors and their Power Units*. Wiley and Sons.

Bernacki, C., Haman, J. and Kanafajski, C.Z.1972. *Agricultural Machines* Oxford & IBH.

Bosoi, E.S., Verniaev, O.V. and Sultan-Shakh, E.G. 1990. *Theory, Construction and Calculations of Agricultural Machinery.* Vol. I. Oxonian Press.

Klenin, N.I., Popov, I.F. and Sakoon, V.A. 1987. *Agricultural Machines. Theory of Operations, Computing and Controlling Parameters and the Condition of Operation.* Amrind Publ.

Ralph Alcock.1986. *Tractor Implements System*. AVI Publ.

Sharma, P.C. and Aggarwal, D.K. 1989. *A Text Book of Machine Design*. Katson Publishing House.

Theory and Construction. Vol. I. U.S. Dept. of Commerce, National Technical Information Service, Springfield, Virginia.

William, R. Gill and Glen E Vanden Berg. 1968. *Soil Dynamics in Tillage and Traction*. US Govt. Printing Office, Washington, D.C.

AE 615 SOIL DYNAMICS IN TILLAGE AND TRACTION (2L+1P) II

Objective

To acquaint and equip with the dynamic properties of soil, soil failure and design of tillage tools, prediction of traction performance and dimensional analysis of different variables related to soil-tire system.

Theory

UNIT I

Dynamic properties of soil and their measurements.

UNIT II

Stress-strain relationship in soil, failure pattern.

UNIT III

Pulverization, effect of speed; relationship of soil parameters to forces acting on tillage tools.

UNIT IV

Design of soil working implements; mechanics and design of traction and transport devices.

Practicals

Relationship of soil parameters to the forces acting on tillage tools, wheel slippage and tyre selection, design and performance of traction devices and soil working tools.

Suggested readings

Daniel, Hill. 1962. *Fundamentals of Soil Physics*. Academic Press.

Gill and Vandenberg.1968. *Soil Dynamics in Tillage and Traction*. Supdt. Of Documents, U.S. Govt. Printing Office, Washington, D.C.

Sineokov, G.N. 1965. *Design of Soil Tillage Machines*. INSDOC, New Delhi.

Terzaghi, K. and Peck Ralph B.1967. *Soil Mechanics in Engineering Practices*. John Wiley & Sons.

AE 616 PRODUCTION TECHNOLOGY (2L+IP) I

Objective

To acquaint and equip with advance techniques of production of agricultural machines

Theory

UNIT I
Reliability of engineering. product, risk analysis. workshop planning and layout.

UNIT II
Theory of plastic properties and heat treatment of metals, workshop practices applied in prototype production

UNIT III
Common tools, press operations: theory and practice of welding; welding processes; metal cutting and machining process; jigs, fixtures and gauges; casting and die casting processes

UNIT IV
Non-traditional methods of machining.

UNIT V
Computer aided manufacturing system, CNC, DNC, robotics.

Practicals

Hands on practices on different aspects covered in the theory.

Suggested Reading

S K Chaudhari. Elements of Workshop technology Vol. 1 and 2.

S. K. Garg. Workshop Technology (Manufacturing Process).

AE 618 ADVANCED FARM MACHINERY DESIGN (2L+1P) III

Objective

Design of power operated agricultural machines including computer simulated designs.

Theory

UNIT I
Principles of design and development of agricultural machines; hydraulic and mechanical power transmission systems; linkages on agricultural machines safety devices on farm equipment.

UNIT II
Design characteristics and force analysis of various soil working tools; design standards and operation of seed drills and planters; design and operation of machines for chemical plant protection.

UNIT III
Design of forage, root crops and grain harvesting equipment; design factors and equipment for threshing and winnowing of crops.

UNIT IV
Utilization efficiency and performance of various agricultural machines; introduction to computer simulated designs.

Practical

Design of power transmission system with case study of vertical conveyor reaper, design of seed metering devices, aqua-ferti seed drill, okra planter, raised bed planter and zero till drill, designs of threshing and feeding units, introduction to computer simulated designs.

Suggested Readings

Bevan, T. 1962. *The Theory of Machines*. Longman.

Close, C.M., Fredrick, D.K. and Newwell, I.C. 2001. *Modelling and Analysis of Dynamic System*. John Wiley & Sons.

Franklin, G.F. and Powell, J.D. 1980. Digital Control of Dynamic System.Addison Wesley Publ.

Kepner, R.A., Bainer, R. and Berger, E.L. 1978. *Principles of Farm Machinery*.AVI Publ.

Mabie, H.H. and Ocrirk, F.W.1987. *Mechanism and Dynamics of Machinery*.John Wiley & Sons.

Shigley, J.E. and Uicker, J.J.1980. *Theory of Machinery and Mechanism*. McGraw Hill.

AE 619 TRACTOR SYSTEMS DESIGN (2L+1P) II

Objective

To acquaint and equip with the latest design procedures of tractor and its systems.

Theory

UNIT I

Thermodynamic principles of I.C. engine, testing of I.C. engine, engine design principles, modern trends in tractor design.

UNIT II

Traction, drawbar performance, mechanics of 2WD & 4WD farm tractors, tractor stability analysis.

UNIT III

Mechanical and power Steering, tractor hydraulics, power transmission systems, tractor tests and performance.

UNIT IV

Tractor test codes, pollution control technologies, human engineering factors in tractor design, Indian tractor industry.

Practicals

Practicals on the systems mentioned in the theory.

Suggested Readings

Arther, W. Judge 1967. *High Speed Diesel Engines*. Chapman & Hall.

Barger, E.L., Liljedahl, J.B. and McKibben, E.C. 1967. *Tractors and their PowerUnits*. John Wiley and Sons.

Macmillan, R.H. *The Mechanics of Tractor - Implement Performance, Theory and Worked Example*. University of Melbourne.

Maleev, V.L. 1945. *Internal Combustion Engines*. McGraw Hill.

Ralph, Alcock 1986. *Tractor Implements System*. AVI Publ. Co.

AE 620 GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING FOR LAND AND WATER RESOURCE MANAGEMENT (2L +1P) II

Objective

To acquaint and equip with the techniques of remote sensing and application of GIS for land and water resources management.

UNIT I

Introduction to the Geographic Information System (GIS) and Remote Sensing (RS); Advantage of GIS and RS in management of land and water resources.

UNIT II

Application of GIS and RS in preparation of land use, soil type, water resources maps.

UNIT III

Use of the delineated maps as input to different process based models for quantification of surface and ground water resources; Use of the tools in change detection studies; disaster management; delineation of waterlogged and degraded lands and their management; design of irrigation networks, targeting potential water harvesting zones;

UNIT IV

Development of optimal land use plan based on the land and water resources on watershed basis

UNIT V

Case studies on GIS and RS application for optimal use of land and water resources.

Practicals

Familiarization with remote sensing and GIS hardware, software and their principle of working, Methods of establishing ground truth, comparison between ground truth and remotely sensed data, application of GIS packages.

Suggested Reading

De Mess MN. 2004. *Fundamental of Geographic Information System*. John Wiley & Sons.

Lille Sand T & Kaiffer R.1987. *Remote Sensing and Image Interpretation.* John Wiley & Sons.

Sabbins F.1987. *Remote Sensing Principle and Interpretation*. Freeman

AE 621 GROUND WATER DEVELOPMENT AND MANAGEMENT TECHNOLOGY (2L+1P) I

Objective

To acquaint and equip the students with the techniques of groundwater development and management

Theory

UNIT I

Occurrence of groundwater, temporal and spatial variability of groundwater, methods for groundwater exploration, determination of aquifer parameters, pumping tests, assessment of groundwater potential,

UNIT II

Groundwater structures, groundwater development and utilization, types of water wells, design and construction of water wells, drilling methods, well development , well maintenance and rehabilitation, groundwater monitoring, monitoring wells, design and construction of monitoring wells,

UNIT III

Groundwater development and quality considerations, groundwater contamination, sources and causes of groundwater pollution, contaminated systems and their rehabilitation, groundwater bioremediation, management of salt water ingress in inland and coastal aquifers,

UNIT IV

Management of declining and rising water table, Natural and artificial groundwater recharge, Groundwater recharge basins and injection wells,

UNIT V

Groundwater management in irrigation command, conjunctive water use, water lifting, different types of pumps, selection of pumps, pump characteristics curve, cost of groundwater pumping, comparative economics of surface and groundwater use for irrigation

UNIT VI

Major issues related to groundwater development and management in India, Legal aspects of groundwater exploitation, Diagnostic survey of sick wells/tube wells and their rehabilitation.

Practicals

Pumping test analysis: determination of aquifer parameters, assessment of groundwater potential, groundwater monitoring, development of conjunctive water use plan, design of tubewell and selection of screen, pump characteristics curve and selection of pumps, construction and analysis of flow net and estimation of seepage flow, groundwater modelling: physical models, application of mathematical models, selection and design of artificial groundwater recharge structure

Suggested Readings

Walton, W.C. 1976. Groundwater Resource Evaluation. McGraw Hill. New York.

Karanth, K.R. 1987. Groundwater Assessment, Development and Management. Tata- McGraw Hill. New Delhi.

Michael, A.M. and Khepar, S.D. 1989. Water Well and Pump Engineering. Tata-McGraw Hill Publ. Co. New Delhi.

Giordano, M. and Villholth, K.G. 2007. The Agricultural Groundwater Revolution Volume 3. CABI Head Office, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, UK

Ghosh, N.C. and Sharma, K.D. 2006. Groundwater Modelling and Management.

Madan Kumar Jha and Stefan Peiffer Applications of Remote Sensing and GIS Technologies in Groundwater Hydrology: Past, Present and Future.

AE 622 OPEN CHANNEL HYDRAULICS (3L+lP) I

Objective

To acquaint and equip with hydraulics of flow in open channel

Theory

UNIT I

Open channel flow and its classification: open channels and their properties; energy and momentum principles; critical flow-its computation and analysis; uniform flow and its computation.

UNIT II

Concepts of boundary layer; surface. roughness; velocity distribution and instability to uniform flow.

UNIT III

Theory, analysis and methods of computations of gradually varied flow.

UNIT IV

Hydraulic jump; gradually varied and rapidly varied unsteady flow.

UNIT V

Hydraulic structures for on-farm application and use in energy dissipation and special applications.

Practicals

Extensive practices on different aspects covered in the theory.

Suggested Readings

Chaudhry, M.H. 1993. *Open Channel Flow*. Prentice Hall.

Chow, V.T. 1959. *Open Channel Hydraulics*. Mc-Graw Hill.

Henederson, F.M. 1966. *Open Channel Flow*. MacMillan

Subramaninum 1960. *Open Channel Flow*. McGraw Hill.

AE 623 SOIL MECHANICS (3L+ lP) I

Objective

To acquaint and equip with engineering properties of soil with respect to design of soil structures.

Theory

UNIT I

Physical and engineering properties of soil, stress, deformation, shear strength, consolidation, stability and compaction, gradation, moisture content, compaction of soils for earth dams, embankments, piles, foundation and walls theory.

UNIT II

Pressure distribution diagram, earth pressure theory, retaining walls, forces acting on earth retaining structures, lateral earth pressure, Coulomb's earth pressure theory, assumptions and deficiencies, active and passive earth pressures.

UNIT III

Bearing capacity of soils, stability requirements of a foundation, soil rating, soil loading tests, Housel's bearing capacity method, perimeter-area ratio method.

UNIT IV

Settlement and lateral expansion of soils.

Practicals

Extensive practices on different aspects covered in the theory.

Suggested Readings

Daniel Hill. 1962. *Fundamentals of Soil Physics*. Academic Press.

Gill and Vandenberg.1968. *Soil Dynamics in Tillage and Traction*. Supdt. Of Documents, U.S. Govt. Printing Office, Washington, D.C.

Sineokov, G.N. 1965. *Design of Soil Tillage Machines*. INSDOC, New Delhi.

Terzaghi, K. and Peck Ralph B.1967. *Soil Mechanics in Engineering Practices*. John Wiley & Sons.

Aysen, A. 2006. Soil Mechanics: Basic Concepts and Engineering Applications, Taylor & Francis.

Punmia, B.C. 2005 .Soil Mechanics and Foundations. Laxmi Publications.

AE 625 ADVANCED HYDROLOGY (3L+lP) II

Objective

To impart advanced knowledge of hydrological processes and modelling

Theory

UNIT I
Mathematical modeling of hydrologic processes-precipitation, infiltration, evapo-transpiration, run-off, soil water balance.

UNIT II
Probabilistic analysis of rainfall for irrigation scheduling.

UNIT III
Rainfall-run-off relationships; analysis of hydrographs.

UNIT IV
Watershed modeling.

UNIT V
Frequency analysis for design of hydrologic systems; time series analysis for hydrologic design and forecasting.

Practicals

Hydrologic budget, Probabilistic analysis of rainfall for irrigation scheduling and Frequency analysis-I

Probabilistic analysis of rainfall for irrigation scheduling and Frequency analysis-II, Regression analysis Time series analysis for hydrologic design and forecasting-I, Hydrologic design, Analysis of Hydrograph, Modelling of hydrological Processes

Suggested Readings

Chow, V.T., David, M. and Mays, L.W. 1988. *Applied Hydrology*. McGraw Hill.

Ghanshyan Das 2000. *Hydrology and Soil Conservation Engineering*. Prentice Hall.

Tideman, E.M. 1996. *Watershed Management*. Omega Scientific Publ.

AE 626 FARM DRAINAGE SYSTEMS DESIGN (3L+IP) II

Objective

To acquaint and equip with the importance and phenomenon of drainage system along with design consideration of surface and sub-surface drainage systems.

Theory

UNIT I

Hydrologic basis for drainage system design; occurrence of floods; analysis of rainfall for drainage system design; analysis of flow into and through soil upto effective root zone depth.

UNIT II

Drainage and crop production; types of drains; surface drainage systems; sub-surface drains in homogenous isotropic soils and anisotropic .heterogeneous soils; drainage for salinity control.

UNIT III

Soil dynamics in a sub-surface drained soil; computational analysis for solution of flow and draw-down problems.

UNIT IV

Basics of drainage coefficients and degree of desirable drainage; drainage structures; design, layout and construction of farm drainage systems considering rainfall, topography, soil and crops; gravity-cum-pump drainage systems.

UNIT V

Drainage using tubewells (vertical drainage); macro-drainage system considerations in design; outlet considerations, drainage modeling; legislation involved.

Practicals

Measurement of in-situ hydraulic conductivity, estimation of drainage coefficient and leaching requirements, delineation of waterlogged areas through isobar, isobath and topographic maps, design of surface and subsurface drainage systems, design of filter and envelop materials.

Suggested Readings

Battacharaya, A.K. and Micheal, A.M. 2003. *Land Drainage*. Vikas Publ.

Clande, Ayres and Daniel Scoates, A.E. 1989. *Level Drainage and Reclamation*. McGraw Hill.

Luthin, J.N. 1978. *Drainage Engineering*. Wiley Eastern.

Ritzema, H.P. (Ed.). 1994. *Drainage Principles and Applications*. ILRI

Roe, C.E. 1966. *Engineering for Agricultural Drainage*. McGraw Hill.

AE 627 FLUID MECHANICS (3L+IP) I

Objective

To acquaint and equip with the latest knowledge in the field of fluid mechanics

Theory

UNIT I

Review of fluid properties and definitions.

UNIT II

Fluids flow concepts and basic equations; kinetics and dynamics of fluid flow; method of describing motion, velocity, acceleration.

UNIT III

Euler's equation; stress and deformation components for general cases.

UNIT IV

Fundamental equations derived from principles of mass transfer and conservation of mass, momentum and energy.

UNIT V

Ideal fluid flow requirements; vortex, irrotational and rotational flow; velocity potential; stream function; flow net.

UNIT VI

Two and three dimensional flow; boundary layer theory; velocity distribution; transition from laminar to turbulent flow; Heleshaw models.

Practicals

Extensive practical on different aspects of fluid mechanics.

Suggested Readings

Modi, P.N. and Seth, S.M. 2000 *Hydraulic and Fluid Mechanics*. Standard Book House.

Burce R. Munson, Donald F. Young. Fundamentals of Fluid Mechanics, sixth edition

Robert W.Fox and Alan T Mcdonald. Introduction to fluid Mechanics.

Morle Potter and david Wiggert. Schaums outline of Fluid Mechanics.

Yunus a Cargel and John M. Cimberla. Fluid Mechanics (Mcgraw Hill Series).

Joseph B Franzini and E John Finnerana. Fluid Mechanics with Engineering applications.

AE 628 FLOW THROUGH POROUS MEDIA (2L+IP) III

Objective

To acquaint and equip with the hydraulics and process of water flow in the water bearing formation under saturated as well as unsaturated conditions

Theory

UNIT I

Physical and chemical properties for the medium and the fluid.

UNIT II

Theories of saturated flows; confined and unconfined flow phenomena and analysis; steady and unsteady flow phenomena and analysis.

UNIT III

Classical capillary models; parallel, serial and branching types of models; Hogen, Poissenlls, Iberal and Gibb's theories: Venzol's model: diffusion theory; Philip's equation and Muskat models.

Practicals

Experiments on concepts mentioned in theory.

Suggested Readings

Harr Milton E. 1962. *Groundwater and Seepage*. McGraw-Hill.

Jacob Beer 1972. *Dynamics of Fluid Flow in Porous Media*. Elsevier.

Muskat M & Wyckoff RD. 1946. *The Flow of Homogeneous Fluids through Porous Media*. JW Edwards.

Patrick A Domenico & Schwartz FW. 1998. *Physical and Chemical Hydrogeology*. John Wiley & Sons.

Remson I, Hornberger GM & Moiz Fred J. 1971. *Numerical Methods in Subsurface Hydrology*. Wiley Interscience.

AE- 629 IRRIGATION SYSTEMS DESIGN (2L +1P) II

Objective

To acquire knowledge about the advances made in irrigation for design of irrigation system for water and land management

Theory

UNIT I

Methods of irrigation, selecting an irrigation method, design, construction and layout of different surface water application methods.

UNIT II

Field measurements for evaluating and improving uniformity and efficiency, hydraulic simulation of surface systems.

UNIT III

Application of Computer Software for Surface Irrigation, Surface Irrigation System, Automation; Land levelling and its effect on irrigation efficiency.

UNIT IV

Pressurized irrigation methods, sprinkle and micro-irrigation systems; hydraulics of drip system, suitability of pressurized systems and their design considerations, layout and uniformity determination; application of software for design of sprinkler and micro-irrigation systems; modeling of water dynamics under different methods of irrigation; irrigation with poor quality water.

UNIT V

Design of sub surface drip irrigation system and software and hard ware of automated micro irrigation systems; case studies on enhanced water use efficiency using micro irrigation and its socio-economic evaluations and adoption by farming community.

Practicals

Land levelling; Software's for the design of sprinkler and drip system , Automation of surface and pressurized systems, water quality, Repair & maintenance of pressurized irrigation systems, Selection of pressurized system components.

Suggested Readings

Doneen, D. and D.W. Westcot. 1984. Irrigation Practice and Water Management. FAO, Irrigation and Drainage Paper 1 (Rev.), Rome, 63 pp

Doorenbos, J. and Kassam, A.H. 1979. Yield Response to Water, Irrigation and Drainage Paper 33, FAO, Rome, Italy.

Murty, V.V.N. 1998. Land and Water Management Engineering, Kalyani Publishers, New Delhi.586p.

Michael, A.M. 2007. Irrigation: Theory and Practice. Vikash Publishing House Pvt. Ltd., New Delhi.

Postel, S. 1999. Pillar of Sand. W.W. Norton & Company, New York, N.Y. 313 pp.

Walker, W.R. and G.V. Skogerboe. 1987. Surface irrigation theory and practice. Prentice-Hall, Inc. (ISBN 0-13-877929-5), pp 3-6.

Wu, I-Pai and Gitlin, H.M. 1974. Design of Drip irrigation lines, Tech. Publ. No. 96, Hawaii Agric.Exp., Stat., University of Hawaii

AE 630/PHT 630 HEAT AND MASS TRANSFER (3L+0P) I

Objective

To acquaint and equip the students with the principles of heat and mass transfer and its applications in food processing.

Theory

UNIT I

Modes of heat and mass transfer: uni- and multi-directional heat conduction; principles of conservation; boundary layer and turbulence: momentum and energy equations.

UNIT II

Convective heat transfer in food processing systems involving laminar and turbulent flow heat transfer in boiling liquids, heat transfer between fluids and solid foods.

UNIT III

Radioactive heat transfer and its governing laws, its applications in food processing.

UNIT IV

Mass transfer; heat and mass transfer analogy; molecular diffusion of fluids; mass transfer operations; absorption; adsorption; extraction-exchange and leaching.

Suggested Readings

Benjamin, G. 1971. *Heat Transfer*. 2nd Ed. Tata McGraw Hill.

Coulson, J.M. and Richardson, J.F. 1999. *Chemical Engineering*. Vol. II, IV. The Pergamon Press.

Earle, R.L. 1985. *Unit Operations in Food Processing*. Pergamon Press.

EcKert, E.R.G. and Draker, McRobert 1975. *Heat and Mass Transfer*. McGraw Hill.

Geankoplis, J. Christie 1999. *Transport Process and Unit Operations*. Allyn & Bacon.

Holman, J.P. 1992. *Heat Transfer*. McGraw Hill.

Kreith Frank 1976. *Principles of Heat Transfer*. 3rd Ed. Harper & Row.

McCabe WL & Smith JC. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.

Treybal RE. 1981. *Mass Transfer Operations*. McGraw Hill.

Warren Gredt H. 1987. *Principles of Engineering Heat Transfer*. Affiliated East-West Press.

AE 631/PHT 631 DRYING AND DEHYDRATION (2L+lP) II

Objective

To acquaint and equip the students with drying and dehydration of grains and seeds and the design features of the equipments used.

Theory

UNIT I

Kinetics of moisture sorption and description, mechanism of moisture transport.

UNIT II

Theory of drying, drying rate calculation, methods of drying grains, seeds and forage crops, dehydration techniques for different food products,

UNIT III

Effect of drying and dehydration on physico-chemical compositions.

Practicals

Determination of moisture content by direct and indirect methods, determination of drying characteristics under sun, mechanical (tray type, fluidized bed type) of grains, seeds, study of different types of dryers (LSU, batch, RPEC etc)

Suggested Readings

Gregg *et al.* 1970. *Seed Processing*. NSC.

Henderson, S. and Perry, S.M. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publ.

Sahay, K.M. and Singh, K.K. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

AE 632 DESIGN OF STORAGE STRUCTURES (lL+lP) I

Objective

To acquaint and equip the students with the safe storage of food materials, design of storage structures and the design of different material handling equipments used in the industries.

Theory

UNIT I

Storage losses of food materials due to microorganisms, enzymes, moisture and insects.

UNIT II

Treatments of agricultural products for longevity in storage, equilibrium moisture content, moisture migration.

UNIT III

Different methods of storage, basic principles in design of grain storage structures, effect of friction, pressure distribution and flow characteristics, design of fans and aeration ducts,

UNIT IV

Salient features in design of cold storage structures.

Practicals

Quality evaluation of stored products, design of storage structures, cold storage, load estimation, construction, maintenance, static pressure drop, estimation of storage loss, and quality of stored products.

Suggested Readings

FAO. 1984. *Design and Operation of Cold Stores in Developing Countries*. FAO.

Hall, C.W. 1970. *Handling and Storage of Food Grains in Tropical and Sub-tropical Areas*. FAO Publ. Oxford & IBH.

Henderson, S. and Perry, S.M. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publ.

Multon, J.L. (Ed). 1989. *Preservation and Storage of Grains, Seeds and their By-products*. CBS.

Shefelt, R.L. and Prussi, S.E. 1992. *Post Harvest Handling – A System Approach*. Academic Press.

Vijayaraghavan, S. 1993. *Grain Storage Engineering and Technology*. Batra Book Service.

AE 633 DESIGN OF PROCESSING PLANTS (3L+0P) II

Objective

To acquaint and equip the students with the design features of different food processing equipment used in the industries, layout and planning of different food and processing plants.

Theory

UNIT I

Raw food materials, harvesting, handling and packaging of food materials.

UNIT II

Unit operations in processing plants, plant layout and its evaluation.

UNIT III

Salient features of processing plants for cereals, horticultural crops, poultry and meat products.

UNIT IV

Guidelines for design and cost analysis of processing plants.

Practical

Selection of a food processing plant system and development of a plant design report including product identification and selection, site selection, estimation of plant size, process and equipment selection, process flow-sheeting, plant layout, and its evaluation and profitability analysis.

Suggested Readings

Ahmed, T. 1997. *Dairy Plant Engineering and Management*. 4th Ed. Kitab Mahal.

Chakraverty, A. and De, D.S. 1981. *Post-harvest Technology of Cereals, Pulses and Oilseeds*. Oxford & IBH.

Gary, Krutz, Lester Thompson and Paul Clear. 1984. *Design of Agricultural Machinery*. John Wiley & Sons.

Hall, C.W. and Davis, D.C. 1979. *Processing Equipment for Agricultural Products.* AVI Publ.

Henderson, S. and Perry, S.M. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publ.

Johnson, A.J. 1986. *Process Control Instrumentation Technology*. 2nd Ed. Wiley International & ELBS.

Rao, T. 1986. *Optimization: Theory and Applications*. 2nd Ed. Wiley Eastern.

Richey, C.B. (Ed.). 1961. *Agricultural Engineers' Hand Book*. McGraw Hill.

Romeo T. Toledo. 1997. *Fundamentals of Food Process Engineering*. CBS.

Slade, F.H. 1967. *Food Processing Plant*. Vol. I. Leonard Hill Books.

AE 634 UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING (3L+0P) III

Objective

To acquaint and equip the students with different unit operations of food industries.

Theory

UNIT I
Size reduction, sorting and grading after threshing.

UNIT II
Dehusking and milling, principles of cleaning, aspiration and ventilation.

UNIT III
Extrusion, materials handling devices and their operational features.

UNIT IV
Packaging machinery and materials.

Suggested Readings

Brennan, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.I. 1990. *Food Engineering Operations*. Elsevier.

Earle, R.L. 1985. *Unit Operations in Food Processing*. Pergamon Press.

Fellows, P. 1988. *Food Processing Technology: Principle and Practice*. VCH Publ.

McCabe, W.L. and Smith, J.C. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.

Sahay, K.M. and Singh, K.K. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

Singh, R.P. and Heldman, D.R. 1993. *Introduction to Food Engineering*. Academic Press.

AE 642 FARM STRUCTURES AND ANIMAL HOUSING (2L+0P) II

Objective

To acquaint and equip the students with the design of farm structures and animal housing.

Theory

UNIT I
Types of farm structures and animal housing,

UNIT II
Design of farm structures, environmental control in farms, livestock building and storage structures.

UNIT III
Green house, selection of material and equipment, cost estimation.

Suggested Readings

Albright LD. 1990. *Environmental Control for Animals and Plants*. ASAE Textbooks.

Esmay ML & Dixon JE. 1986. *Environmental Control for Agricultural Buildings*. The AVI Corp.

Gaudy AF & Gaudy ET. 1988. *Elements of Bioenvironmental Engineering*. Engineering Press.

Moore FF. 1994. *Environmental Control Systems: Heating, Cooling, Lighting*. Chapman & Hall.

Threlkeld JL. 1970. *Thermal Environmental Engineering*. Prentice Hall.

AE 645 NUMERICAL METHODS IN FLUID FLOW AND HEAT TRANSFER (2L+ 1P) II

Objective

To acquaint and equip with numerical methods and their application in problem solving in agricultural engineering

Theory

UNIT I
Review of governing equations and their classifications

UNIT II
Discretization procedures; stability; consistency; convergence;

UNIT III
Alternative methods; problem formulation;

UNIT IV
Applications for steady state and time dependent problems.

Practicals

Extensive practices on the methods mentioned in the theory

Suggested Readings

Balagurusamy, E. 2000. *Numerical Methods*. Tata McGraw Hill.

Robert, J. Schilling and Sandra, L Harries. 2002. *Applied Numerical Methods for Engineers Using MATLAB and C*. Thomson Asia.

Veerarajan, T. and Ramachnadran, T. 2004. *Numerical Methods with Programmes in C and C++*. Tata McGraw Hill.

Steven, C. Chapra and Raymond, P. Canale. 2000. *Numerical Methods for Engineers with Programming and Software Applications*. Tata McGraw.

AE 652 WATERSHED HYDROLOGY AND MANAGEMENT (2L+1P) III

Objective

To acquaint and equip the students with the watershed management systems

Theory

UNIT I

Introduction to watershed hydrology, its management and agricultural sustainability issues; need of integrated watershed management in India; delineation of watersheds.

Hydrology of watershed systems; estimation of surface runoff and sediment yields; effect of precipitation and hydro-climatic conditions on watershed systems; watershed erosion processes and its prevention; instrumentation and measurement of watershed management indicators.

UNIT II

Mechanical and vegetative interventions for prevention of erosion and moisture conservation in watersheds; water quality issues in watersheds; optimal land use planning in watersheds.

UNIT III

Use of GPS, GIS, RS and Decision Support Systems (DSS) in watershed management; technologies for rain-fed farming; socio-economic evaluation of the watershed management projects.

UNIT IV

Peoples' participation and livelihood analysis; cropping system and resource conservation techniques in watersheds.

UNIT V

Heuristics and indigenous technical knowledge (ITKs) in watershed management; watershed associations and groups in villages of India; Government policies, acts and schemes on watershed management

Practicals

Experiments on concepts mentioned in theory

Suggested Readings

Isobel W Heathcote. 1998. *Integrated Watershed Management: Principles and Practice*. Wiley Publ.

Kenneth N Brooks, Peter F Ffolliott, Hans M Gregersen, Leonard F DeBano. 1991. *Hydrology and the Management of Watersheds*. Wiley-Blackwell.

AE 653 MODELLING IN INTEGRATED WATER RESOURCES MANAGEMENT (2L+1P) III

Objective

To acquaint and equip the students with the integrated resources management, modeling and modeling systems

UNIT I

Introduction to modeling, model types, models in soil and water resources; model selection techniques; database requirement, availability, generation and use for model development. Development of conceptual and physics based models.

UNIT II

Use of numerical methods in model development and use of Geographic Information System (GIS) tool. Advantage of model hybridization over individual model types, model calibration, validation and testing for accuracy, consistency and sensitivity.

UNIT III

Use of expert system techniques, heuristics in soil and water resources; development of expert watershed systems; use of artificial Neural Networks in modeling.

Practicals

Application of Models in integrated resources management. Application of watershed models.

Suggested Readings

Isobel W Heathcote**.** 1998. *Integrated Watershed Management: Principles and Practice*. Wiley Publ.

Kenneth N Brooks, Peter F Ffolliott, Hans M Gregersen, Leonard F DeBano. 1991. *Hydrology and the Management of Watersheds*. Wiley-Blackwell.

AE 655 ADVANCED GROUND WATER HYDRAULICS (3L+0P) III

Objectives

To impart advance knowledge on groundwater flow and solute transport.

Theory

UNIT I

Aquifers and aquifer materials, aquifer parameters, homogeneity and isotropy, hydraulic head and fluid potential,

UNIT II

Principals of groundwater flow, Darcy's law, Darcy's experiment, potential flow, flow nets and seepage analysis, groundwater flow equation, solution of groundwater flow equation, Well hydraulics, steady and unsteady flow through fully penetrating and partially penetrating wells in confined, semi-confined and unconfined aquifers, multiple wells and interference between wells, initial and boundary conditions, flow into aquifer with different boundaries,

UNIT III

Solute transport, advection and dispersion, sorption and diffusive mass transfer, pollution dynamics, hydrodynamics dispersion,

UNIT IV

Introduction to groundwater models, analytical and numerical modelling of groundwater flow, Modeling regional groundwater flow and contaminant transport, Sea water intrusion in inland and coastal aquifers, Gyben-Herzberz principle of salt-water intrusion,

UNIT V

Groundwater recharge mechanism, Application emerging of techniques in groundwater investigation.

Suggested Readings

Todd, D.K. 1959. Ground Water Hydrology. John Wiley.

Beer, J. 1979. Hydraulics of Groundwater. McGraw Hill. New York.

Beer, J. and Verruijt. 1987. Modelling Groundwater Flow and Pollution. D. Reidel Publ.Co., Dodrecht, The Netherlands.

Davis, S.N. and Roger J.M. Deweist. 1969. Hydrogeology. John Wiley and Sons. NewYork.

Polubarinova-Kochina, P. Ya and Roger De Wiest. J.M. 1962. Theory of Ground Water Movement, Princeton University Press, Princeton, N.J

AE 656 MACHINERY SYSTEMS FOR PRECISION AGRICULTURE (2L+1P) III

Objective

To acquaint and equip with the farm machinery used for natural resources management and machinery for precision farming. Use of GIS and GPS in farm machinery

UNIT I

Soil sensors in precision farming. Spectral based sensors. Development of sensors and controls.

UNIT II

Variable rate technology. Precision chemical application. Crop yield monitors.

UNIT III

Decision support systems; artificial intelligence.

UNIT IV

Precision sowing and planting machines, laser guided leveler.

UNIT V

Remote sensing for precision agriculture. Vision systems. Field plot machines.

Practicals

Introduction to GIS and GPS, study of models vis-à-vis farm machinery usage. Precision farming using GIS and GPS – case study. Study the mechanism of power shovels, drag lines, earth diggers, clamshells etc. earth work estimation, unit cost of operation, work scheduling, machinery maintenance, entrepreneurship

Suggested Readings

De Mess, M.N. Fundamental of Geographic Information System. John Willy and Sons, New York

Dutta, S.K. 1987. Soil conservation and land management. International distributors, Dehradun.

Kuhar, John. E. 1977. The precision farmimg guide for agriculturalist. Lori J. Dhabalt, USA.

Lille Sand, T. and Kaiffer, R. Remote Sensing and Image Interpretation, John Willy and Sons, London.

Nichols, H.L. and Day, D.H.1998. Moving the earth. The work book of excavation. Mcgraw Hill.

Peurifoy, R.L. 1956.Construction, planning, equipment and methods.Mcgraw Hill.

Sabbins, F. Remote Sensing Principle and Interpretation. Freeman, New York.

Singh, G.1991. Manual of soil and water conservation engineering. Oxford and IBH, Co.

Sigma and Jagmohan. 1976. Earth moving machinery. Oxford & IBH

Wood and Stuart. 1977. Earth moving machinery. Prentice Hall.

AE 657 COMPUTER AIDED ANALYSIS AND DESIGN OF FARM MACHINERY (2L+1P) II

Objective

To acquaint and equip with the computer aided design, analysis and manufacturing of farm machinery with the help of CAD.

Theory

UNIT I

Computer aided design principles of machines. Computer representation of models and drawings.

UNIT II

Features of various solid modeling packages. Usage of packages for dynamic analysis of farm machines and its components.

UNIT III

Design of inclined tillage tools. Development of plough surfaces.

UNIT IV

Solid and wire frame modeling of components of tractor, seed drills and threshers..

UNIT V

Structural analysis and fatigue analysis of tractor and machinery systems Graphic analysis of cutter bar mechanism.

Practicals

Practical on CAD software, its uses and application in design of farm machinery. Design procedures. Exercise on agricultural engineering system analysis. Description of the machinery scheduling problem in harvesting and transport system. Investigation of existing software models – cases studies.

Suggested Readings

Chris McMahon and Jimmie Browne. 2000. *CAD /CAM/ Principles, Practice and Manufacturing Management*. Pearson Edu.

Grover, Mikell P. 2003. *Automation, Production Systems and Computer Integrated Manufacturing*. Prentice-Hall of India.

Radhakrishnan, P., Subramanyan, S. and Raju, V. 2003. *CAD/CAM/CIM*. New Age International.

Rao, P.N. 2002. *CAD/CAM Principles and Applications*. Tata McGraw Hill.

Zeid, Ibrahim.1998. *CAD/CAM Theory and Practice*. Tata McGraw Hill

AE 659 ENERGY CONSERVATION AND MANAGEMENT IN AGRICULTURE (2L+0P) II

Objective

To acquaint and equip with the energy use pattern in agriculture production systems, conservation of energy, energy planning and economics.

Theory

UNIT I

Farm energy resources, their forms and uses, energy coefficients for agricultural inputs and products.

UNIT II

Energy consumption patterns in agricultural production and processing sectors, energy conservation and waste minimization methods, energy efficient machinery systems.

UNIT III

Energy management concepts, energy audit, energy costs, energy performance, system efficiencies, material and energy balance, financial analysis.

UNIT IV

Energy forecasting and demand-supply optimization, fuel and energy substitution, energy action planning.

Suggested Readings

Mittal, J.P., Panesar, B.S., Singh, S., Singh, C.P. and Mannan, K.D. 1987. *Energy in Production Agriculture and Food Processing*. ISAE and School of Energy Studies, Ludhiana. ISAE Publ.

Pimental, D. 1980. *Handbook of Energy Utilization in Agriculture*. CRC Press.