Ph. D. Syllabus in the Department of Agricultural Engineering

Course Code	Course Title	Credits
AEG 600 (course-I)	Research Methodology and Techniques	4
AEG 601 Course-III	Review of Research Work and Written Presentation of Synopsis	4
AEG 602 (course - II)	Advances in Food and Agricultural Process Engineering	4
AEG 603 (course-II)	Advances in Farm Machinery and Power	4
AEG 604 (course-II)	Advances in Soil and Water Conservation Engineering	4
AEG 605 (course-II)	Advances in Bio-Energy Recourses	4

Students can choose any Course-II depending on their M.E/M.Tech (Ag. Engg) specialization

AEG 600 Research methodology and techniques 4+0

Objective:

To acquaint and equip the students with various research methodologies and statistical techniques for their future research work.

Syllabus:

UNIT-1

Research-definition, objectives, research problems, research process, literature review, Characteristics and classification, research methods and techniques; Experimental & quasi-experimental research; sampling techniques.

UNIT-II

Formulation of research problem and hypothesis; Research design; Principles of experimental design; Analysis and statistical techniques; Correlation and regression analysis; Analysis of variance and covariance; Test of significance.

UNIT-III

Optimization software-GAMES applications, image analysis software-applications; general computational software for research-MATLAB-applications; Report writing-interpretation of data style, scientific writing techniques, format of report writing and presentation techniques.

UNIT-IV

Research ethics-scientific temper, research integrity, research safety in laboratories, basic knowledge of working in laboratory, recent experimental techniques, computer ethics, standards and problems in research ethics.

Learning Outcome:

This course enables the students to make their experimental designs, statistical analysis, and error estimation etc. for their research work. The students will also able to work with the standard statistical software such as SPSS, R and MATLAB etc.

AEG 602 Advances in food and agricultural process engineering 4+0

Objective:

To acquaint and equip the students with various engineering principles and technologies in food and agricultural processing and application of mathematical modeling techniques in food processing operations.

Syllabus:

UNIT-I

Heat preservation of foods-thermo bacteriology, process calculation and selection, low temperature preservation, microbiological aspects; Application of heat and ultrasound-electrical resistance heating, ohmic heating, heating models; High voltage pulse technique-influence on microorganisms, food ingredients; Surface heat treatment-decontamination of microorganisms.

UNIT-II

Principles of transport processes-mass, energy and momentum transfer, differential equations of continuity, dimensional analysis in momentum transfer. Heat transfer in non-Newtonian fluids and its coefficients; Unsteady state heat conduction, thermal processing and sterilization; Mass transfer and diffusion-molecular diffusion in gases, liquids, biological solution, gels and solids.

UNIT-III

Low temperature food preservation-cold storage, freeze concentration and membrane process, methods of preservation; Aseptic processing and packaging, Hurdle technology and applications; Food irradiation and its applications; Hydrostatic pressure treatment of food processing and effect on microorganisms; Extrusion cooking-methods, equipment, design of extruders.

UNIT-IV

Food texture-classification, measurements; Sensory methods of texture; Sensory evaluation and correlation between subjective and objective measurements of foods; Rheological and viscoelastic properties of foods and their associated mathematical models; Mathematical models and their application along with pipeline design and pump selection for non-Newtonian fluids.

UNIT-V

Mathematical modelling-correlative and explanatory models, probability models, linear and series mathematical approximation; Stochastic finite element analysis of thermal food processes; Application of mathematical modelling techniques in food processing operations like parboiling, convective drying, pasteurization, dehydration, shelf-life prediction, fermentation, moisture diffusion, infrared heating.

Learning Outcome:

This course enables the students to develop research skill in advanced technology in food and agricultural processing viz. thermal and non-thermal processing, extrusion, ultrasound, infrared, low temperature, aseptic processing, hurdle technology, irradiation, hydrostatic pressure, food texture, etc.

AEG 603. Advances in farm machinery and power 4 +0

Objectives:

To familiarize students with new and advance machinery for farm operations and emphasis on reducing the use of traditional energy sources in farm activities.

Syllabus:

UNIT-I

Farm machinery system and its characteristics evaluation - dynamic characteristics of related components of engine and agricultural machines; Mechanism of dynamic elements and analysis of forces in tractor implement combinations under two and three dimensional conditions. Vibrations, transmissibility and effect of damping on various agricultural machine systems.

UNIT-II

Farm machinery scheduling - selection of size and power level of machinery, economy decisions on equipment; Systems approach - operational constraints, power constraints, weather constraints; Engineering economics - Incremental, differential costs, economic efficiency, time value, operation costs, production costs, uncertainty probability concepts and functions.

UNIT-III

Soil-Machine-Plant relationship - tillage effects on soil physical properties, soil-water retention characteristics, hydraulic conductivity; Changes in soil physical properties by traction devices. Mechanical confinement - application of classical and critical state soil mechanics, modeling tillage effects; Draft force requirement – modeling soil structure after soil machine interaction; Interaction of soil tilth, seed and roots.

UNIT-IV

Ergonomics in farm machinery - human limits and differences, sensing, the body and performance; Cognitive processing and performance - perception, decision making, memory, motivation, problem solving; Basic design and human factors - interface design, human/machine interface, human/computer interface, supporting human performance, selection criteria.

UNIT-V

Simulation modeling in farm machinery – simulation for system modeling, system performance and modeling methodologies; Formulations of simulation model - validation and testing of the simulation model; Sensitivity of models, scale factors; Similitude in tillage tool studies - prediction models for traction devices; Mathematical modeling and programming through ordinary differential equation of first and second order and partial differential equation.

Learning Outcome:

This course will encourage student to use modern and efficient tools and equipments in place of traditional equipment and practices. This will encourage the students to design small equipments to fulfil local requirements.

AEG 604 Advances in soil and water conservation engineering 4+0

Objective:

To acquaint and equip the students with various engineering principles and technologies in soil and water conservation including soil erosion, soil loss estimation, groundwater recharge, hydrology, hydrodynamics in flow, reservoir, well hydraulics, etc.

Syllabus:

UNIT-I

Mechanics of soil erosion by water and wind; Design of water and wind erosion control measures; Computation of soil erosivity and erodibility index. Universal soil loss equation; theory of particle movement, sediment transport and deposition process;

Estimation of sediment suspended load using empirical formulae, sediment yield models; Composition of reservoir sedimentation by sounding method.

UNIT-II

Systems engineering for water management; Complexity of resources management process, system analysis; Rainfall, runoff and infiltration models, Simulation methods, structure of a water balance model; Channel flow simulation, stream flow statistics, surface water storage requirement. Flood control, reservoir capacity and surface water allocations.

UNIT-III

Groundwater movement and storage-ground water models, hydrologic models, uncertainity in hydrological event; Well hydraulics-two dimensions flow, steady and unsteady state flow in confined, unconfined and semi-confined aquifers, steady flow in sloping aquifers, analysis of multi-aquifers and determination of aquifer parameters. Flow analysis in interfering wells.

UNIT-IV

Concept of different types of for simulation of hydrologic problems. Groundwater modelling for water resources, planning and techniques for groundwater recharge, frequency analysis. Co-relation, regression analysis and probability distribution of hydrological variables. Formulation of various steps of statistical models and their application in hydrology.

UNIT-V

Hydrodynamics in flow through porous media, hydrodynamic dispersion, diffusion; Analytical and numerical models of contaminant transport in unsaturated soil profile and ground water; water quality management in lakes, reservoirs and groundwater; hydrologic and chemical budgets, bio-geochemical processes of pollutants; Biological wastewater treatment; Modern stream pollution problem and environment impact assessment.

Learning Outcome:

This course enables the students in advances in soil and water conservation engineering such as soil loss, sedimentation, rainfall models, channel flow, groundwater modelling, well hydraulics, hydrologic models, hydrodynamics in flow, biological wastewater treatment, etc.

AEG 605. Advances in bio-energy resources 4 +0

Objectives:

To acquaint and equip the students with alternative energy sources for carrying out farm activities and importance

Syllabus:

UNIT-I

Environmental waste recycling - handling, composting, biological processing, energy recovery; Recycling of industrial/agro-industrial wastes – waste from industries like sugar, dairy, rice milling, fruit processing; Bio-waste energy utilization - waste heat recovery, heat generation, heat pump; Gaseous pollutants - absorption, regeneration systems; Thermal pollution – discharge, cooling towers; Solid waste pollution; Environment assessment at power sites.

UNIT-II

Biochemical conversion of organic wastes - high solid digestion of biomass, collection, storage, utilization, sludge treatment, methane production, alcohol production - cellulose degradation; Gasohol – pretreatment, kinetics of conversion; Thermo chemical conversion of organic wastes - biomass characterization, fluidized bed gasification, fixed bed gasification, pressurized gasification; Liquefaction - types and analysis.

UNIT-III

Biomass Pyrolysis - simplified models for pyrolysis, pyrolysis regimes, stages heating, numerical computations, kinetic evaluation of effect of particle size, partial pressure; Time Temperature variation of surface area, random pore model of pyrolysis zone, moving boundary model of pyrolysis, effect of radiant heat flux, thermo gravimetric study; Heterogeneous reactions -fluidized bed reactors, mathematical models, bubble assemblage model.

UNIT-IV

Solar energy system analysis - solar thermal power, flat plate and parabolic collectors, desiccant; Photovoltaics - thermodynamic limitations of photo cells, amorphous thin film applications, Thermophoto voltaics - generator system, cogeneration, technology assessment, commercial development; Solar Applications - multi green house, solar irrigation system, combination grain dryer, industrial application, micro processor based control and instrumentation.

UNIT-V

Wind energy system analysis - wind speed, velocity, power, frequency curves, energy factors, estimation of annual energy, and variations of wind speed with time, reliability and economics of wind flow hills, effect of altitude, frictional drag, wind structure; Wind rotors - gust forces acting on the blade system, influence of structure on the design of wind rotors, dynamic behavior of straight blades, effect of speed, turbulence and induced loads on rotor; Power plants – electric generator for industrial applications.

Learning Outcome:

The students will able to use their skill in using alternative energy sources such as biomass gasifier, solar panel, bio-fuel, biogas plant, wind energy for carrying out farm activities. It also reduces the use of traditional energy sources such as petroleum products, coal etc.

AEG 601 Review of Research Work and Written Presentation of Synopsis 4+0

Unit I
Meaning of thesis –Some basic dimensions and formality of submission-Components of thesis and their importance
Unit II
Presentation and writing of synopsis
Unit III
Developing Seminar presentation
Unit IV
Writing the introduction-Conducting review of literature - Developing theoretical orientation and framing conceptual model-Organizing research methodology chapter-writing the findings and discussion chapter- drawing the summary and conclusion-writing implications and framing empirical model-citing the references and appendices.