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**SERVICE COURSE**

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*Compulsory courses; @ Courses open for the Department of Processing & Food Engineering and other departments

To be taught by: ❶ Section of Basic Engineering (CE); ❷ Processing & Food Engineering
## FARM MACHINERY & POWER ENGINEERING

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**Objective**

To acquaint and equip with the latest design procedures of farm power and machinery systems.

**Theory**

UNIT-I: Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems. Design considerations, procedure and their applications in agricultural tractors & typical machines. Reliability criteria in design and its application.

UNIT-II: Analytical design considerations of linkages/components in farm machinery and its application.


UNIT-IV: Design and selection of matching power unit.

UNIT-V: Safety devices for tractors & farm implements.

**Practical**

Statement and formulation of design problems. Design of farm power systems. Design of mechanisms and prototypes in farm machinery.

**Suggested Readings**


FMPE 502  SOIL DYNAMICS IN TILLAGE AND TRACTION  2+1  SEM - 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-tyre system.

Theory
UNIT-I: Dynamic properties of soil and their measurement, stress-strain relationships, theory of soil failure.
UNIT-II: Mechanics of tillage tools and geometry of soil tool system, design parameters and performance of tillage tools.
UNIT-III: Dimensional analysis of different variables related to soil-tyre system; soil vehicle models; mechanics of steering of farm tractor; special problems of wet land traction and floatation.

Practical
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
Sineokov GN 1965. Design of Soil Tillage Machines. INSDOC, New Delhi

FMPE 503  TESTING AND EVALUATION OF TRACTORS AND FARM EQUIPMENT  2+1  SEM - II

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

Theory
UNIT-I: Types of tests; test procedure, national and international codes.
UNIT-II: Test equipment; usage and limitations. Power losses in dynamometers and hydraulic test equipment.
UNIT-III: Prototype feasibility testing and field evaluation. Laboratory and field testing of selected farm equipment. Non-destructive testing techniques.
UNIT-IV: Tractor performance testing, evaluation and interpretation of results.
UNIT-V: Review and interpretation of test reports. Case studies.

Practical
Laboratory and field testing of selected farm equipment. Interpretation and reporting of test results. Material testing and its chemical composition. Accelerated testing of fast wearing components. Non-destructive testing techniques.

Suggested Readings
Barger EL, Liljedahl JB & McKibben EC. 1967. Tractors and their Power Units. Wiley Eastern
Lal R & Dutta PC. Agricultural Engineering (through solved examples). Saroj Parkashan, Allahabad.
FMPE 504  FARM MACHINERY DYNAMICS, NOISE  3+1  SEM - I
AND VIBRATIONS

Objective
To acquaint and equip with the theoretical aspects of farm machinery used on the farm.

Theory
UNIT-I: Principles of soil working tools: shares, discs, shovels, sweeps and blades, rotat-
tillers and puddlers.
UNIT-II: Metering of seeds and granular fertilizers with various mechanism, effect of
various parameters on distribution of seed and fertilizer in seed cum fertilizer drills and
planters, flow of seeds and fertilizers through tubes and boots. Kinematics of
transplanters.
UNIT-III: Theory of atomization, specific energy for atomization, electrostatic spraying
and dusting, spray distribution patterns. Kinematics of reapers/harvesting machines.
Theory of mechanical separation of grains from earheads/pods. Parameters affecting
performance of threshers, aerodynamic properties of straw and grain mixture, theory of
root crop harvesters, power requirement of various components of field machines.
UNIT-IV: Noise and vibration theory- Definition, units and parameters of measurement
and their importance. Types of vibrations- free and forced, in damped and without damped
analysis of one, two and multiple degree of freedom systems and their solution using
newton’s motion, energy method, longitudinal, transverse and torsional vibrations,
Rayleigh’s methods, lagrange equation.
UNIT-V: Introduction of transient vibration in systems, vibration of continuous media.
Balancing of single rotating weight and number of weights in same plane and different
planes. Complete balancing of reciprocating parts of engine

Practical
Study of vibration measurement and analysis equipment, Study of different vibration
measurement and evaluation, Measurement and analysis of vibration on different
components of threshers, combine, reaper, power tiller and tractor. Determination of
modulus of elasticity, rigidity, and MI by free vibration test. Evaluation of logarithmic
decrement and damping factor. Whirling of shaft. Heat motion in two pendulum system.
Detailed analysis of multi-degree of freedom system.

Suggested Readings
Bosoi ESO, Verniaev V Smirnov & EG Sultan-Shakh. 1990. Theory, Construction and
Principles of Agricultural Machines (ASAE. Text book No. 6.)
Klenin NL, Popov IF & Sakoon VA. 1987. Agricultural Machines. Theory of Operations,
Computing and Controlling Parameters and the Condition of Operation. Amrind
Publ.
Objective
To acquaint and equip with the concept of instrumentation used in farm power and machinery and measuring devices for force, torque and other parameters.

Theory
UNIT-I: Strain and stress, strain relationship, strain gauges. Mechanical, optical, electrical acoustical and pneumatic etc. and their use. Various methods of determining strain/stresses experimentally. Measuring devices for displacement (linear and rotational), velocity, force, torque and shaft power. Strain gauges: types and their application in two and three dimensional force measurement. Design and analysis of strain gauges.
UNIT-II: Introduction to functional elements of instruments. Active and passive transducers, Analog and digital modes, Null and deflection methods. Performance characteristics of instruments including static and dynamic characteristics.
UNIT-IV: Basic signal conditioning devices - data acquisition system - micro computers for measurement and data acquisition. Data storage and their application.

Practical
Calibration of instruments, experiment on LVDT, strain gauge transducer, inductive and capacitive pick ups, speed measurement using optical devices, vibration measurement exercises , making of thermocouples and their testing- basic electronic circuits and application of linear ICs.

Suggested Readings
Suggested Readings

FMPE 507 SYSTEM SIMULATION AND COMPUTER AIDED PROBLEM SOLVING IN ENGINEERING 1+1 SEM - II

Objective
To acquaint and equip with the concept of dimensional analysis, mathematical modeling, software development process and the use of CAD software and in solving the engineering problems related to design of farm machinery.

Theory
UNIT-I: Concept, advantages and limitation of dimensional analysis, dimensions and units, fundamental and derived units, systems of units, conversion of units of measurement, conversion of dimensional constants, conversion of equations in different units, complete set of dimensionless products and their formulation methods- the Rayleigh’s method, Buckingham’s Pi theorem and other methods.
UNIT-II: Mathematical modeling and engineering problem solving
UNIT-V: Solving differential equation on computers- modeling engineering systems with ordinary differential equations- solution techniques using computers.

Practical
Extensive practice on Software development process, modeling techniques, use of CAD software in solving engineering problems related to design of farm machinery

Suggested Readings

FMPE 508 TRACTOR DESIGN 2+1 SEM - I

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

Theory
UNIT-I: Technical specifications of tractors available in India, modern trends in tractor design and development, special design features of tractors in relation to Indian agriculture.
UNIT-II: Parameters affecting design of tractor engine and their selection. Design of fuel efficient engine components and tractor systems like transmission, steering, front suspension, hydraulic system & hitching, chassis, driver’s seat, work-place area and controls. Tyre selection


Practical
Extensive practices on the design of tractor engine, hydraulic system, driver seat, place area and control.

Suggested Readings

FMPE 509 OPERATIONS RESEARCH IN FARM POWER AND MACHINERY MANAGEMENT 2+1 SEM - II

Objective
To acquaint and equip with the mechanization status in the country and management techniques for future requirements.

Theory
UNIT-I: Nature, methods, impact and scope of operational research; linear programming and integer programming models and applications. Network terminology, shortest route and minimal spanning tree problems, maximal flow problem, project planning and control with PERT and CPM.
UNIT-II: System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection.
UNIT-III: Maintenance and scheduling of operations. Replacement of old machines, repair and maintenance of agricultural machinery, inventory control of spare parts, work study, productivity, method study. First order Markov chains and their applications in sales forecasting and in problems of inventory control and modeling of workshop processes and quality control.
UNIT-IV: Time and motion study. Man-machine task system in farm operations, planning of work system in agriculture. Computer application in selection of power units and to optimize mechanization system.

Practical
Management problems and case studies.

Suggested Readings

FMPE 510 ERGONOMICS AND SAFETY IN FARM OPERATIONS 2+1 SEM - II

Objective
To acquaint and equip with the ergonomic aspects in the design of farm machinery and tractors for safety of human beings.

Theory
UNIT-I: Concept and design criteria for optimum mutual adjustment of man and his work: Importance of ergonomics and its application in agriculture, liberation and transfer of
energy in human body, concept of indirect calorimeter, work physiology in various agricultural tasks.

UNIT-II: Physiological stress indices and their methods of measurement: Mechanical efficiency of work, fatigue and shift work.

UNIT-III: Anthropometry and Biomechanics: Anthropometric data and measurement techniques, joint movement and method of measurement, analysis and application of anthropometric data, measurement of physical and mental capacities.

UNIT-IV: Human limitations in relation to stresses and demands of working environments. Mechanical environment; noise and vibration and their physiological effects, thermal environment; heat stress, thermal comfort, effect on performance and behavior, field of vision, color discrimination, general guidelines for designing visual display, safety standards at work place during various farm operations and natural hazards on the farm. Farm safety legislation.

UNIT-V: Man-machine system concept. Human factors in adjustment of man and his work. Design aspects of foot and hand controls on tractors and farm equipment. Design of operator’s seat for tractors and agricultural equipment.

Practical
Laboratory experiments on measurement of physical and mental capacities and limitations of human-being in relation to the stress and environment, anthropometric measurements, study of human response to dust, noise and vibrations, case studies on ergonomics.

Suggested Readings

FMPE 511/ PFE 502
ENGINEERING PROPERTIES OF BIOLOGICAL MATERIALS
2+1 SEM - I

(To be taught by Processing & Food Engineering)

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

Theory
UNIT-I: Physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Rheology; ASTM standard, terms, physical states of materials, classical ideal material, rheological models and equations, visco elasticity, creep-stress relaxation, Non Newtonian fluid and viscometry, rheological properties, force, deformation, stress, strain, elastic, plastic behaviour.

UNIT-II: Contact stresses between bodies, Hertz problems, firmness and hardness, mechanical damage, dead load and impact damage, vibration damage, friction, effect of load, sliding velocity, temperature, water film and surface roughness. Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials, aero dynamics of agricultural products, drag coefficients, terminal velocity.

UNIT-III: Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, methods of determination, steady state and transient heat flow. Electrical properties; Dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination, energy absorption from high-frequency electric field.

UNIT-IV: Preliminary design criteria of sprinkler and micro irrigation systems, hydraulics of sprinkler and micro irrigation systems. Design of lateral, submain and main line of sprinkler and micro irrigation. Fertigation aspects.
Practical
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, thermal properties like thermal conductivity, thermal diffusivity and specific heat, firmness and hardness of grain, fruits and stalk, electrical properties like dielectric constant, dielectric loss factor, loss tangent and A.C. conductivity of various food materials.

Suggested Readings

FMPE 512 AGRO-ENERGY AUDIT AND MANAGEMENT 2+0 SEM - I
Objective
To acquaint and equip about the sources of energy, conservation of energy and its management. Energy use scenario in agricultural production system, agro-based industry. Study of energy efficiency, energy planning, forecasting and energy economics.

Theory
UNIT-I: Energy resources on the farm: conventional and non-conventional forms of energy and their use. Heat equivalents and energy coefficients for different agricultural inputs and products. Pattern of energy consumption and their constraints in production of agriculture. Direct and indirect energy.
UNIT-II: Energy audit of production agriculture, and rural living and scope of conservation

Suggested Readings:

FMPE 513 DESIGN AND ANALYSIS OF RENEWABLE ENERGY CONVERSION SYSTEMS 3+0 SEM - II
Objective
To acquaint and equip with the conventional and non-conventional energy sources. Energy from biomass, conversion of energy from biomass. Development of biogas and biofuels.

Theory
UNIT-I: Energy cycle of the earth; water flow and storage; ocean currents and tides. Energy heat flow and energy storage; photosynthesis and biomass; renewable energy sources.
UNIT-II: Thermodynamics of energy conversion; conversion of solar energy, wind energy, water flows, heat, biomass, etc.; other conversion processes.


Suggested Readings


FMPE 514 RESEARCH METHODOLOGY 0+1 SEM - I

**Practical**


**Suggested Readings**


FMPE 595 INDUSTRY / INSTITUTE TRAINING 0+1 (NC) SEM – I

(Minimum three weeks)

**Objective**

To expose the students to the industry.

**Practical**

In-plant training in the relevant farm power and machinery industry during manufacturing, assembly and testing of the machines and equipment. To study the actual working of the equipment and various unit operations. The evaluation will be based on the written report of the student and the Comments of the factory managers. The duration of training shall be three weeks. The student shall be required to do training in the institute other than the institute in which he/she is enrolled.
FARM MACHINERY & POWER ENGINEERING

List of Journals

- Agricultural engineering Journal (AIT Bangkok)
- Agricultural Engineering Today
- Indian Journal of Agriculture sciences
- Journal of Agricultural Engineering Research
- Journal of Agricultural Engineering, ISAE, New Delhi
- Journal of Agricultural Mechanization in Asia, Africa and Latin America (AMA)
- Journal of Arid Land Research Management
- Journal of Computer and Electronics in Agriculture
- Journal of Terramechanics
- Seed Research Journal, New Delhi
- Transactions of American Society of Agricultural Engineers (TASAE)

Suggested Broad Topics for Master’s and Doctoral Research

- Farm Machinery for crop residue management to increase soil fertility for higher productivity
- Machinery for precision agriculture for efficient utilization of inputs and saving in cost of production to have higher productivity
- Application of axial flow principle in thresher to have minimum breakage
- Efficient hand tools for pruning and plucking fruits
- Transplanters- to transplant paddy and vegetable crops
- Cotton pickers- for picking cotton balls
- Forage harvesters – for forage crops
- Crop planters- for hybrid cotton, bajra and other crops for hybrid seed production
- Efficient tillage and sowing machinery to save irrigation water and increase productivity.
- Development of farm machinery for horticultural crops
- Use of electronics in agriculture
- Use of GIS and GPS in farm machinery for precision agriculture
- Development of software for optimal use of farm machinery under different agro climatic conditions
## PROCESSING AND FOOD ENGINEERING

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*Compulsory courses; Courses open for PG students of other Dept./Colleges
To be taught by: 1 Processing & Food Engineering; 2 Processing & Food Engineering and Food Science & Technology
PROCESSING AND FOOD ENGINEERING

Course Contents

PFE 501
TRANSPORT PHENOMENA IN FOOD PROCESSING

2+1
SEM - II

Objective
To acquaint and equip students about hydrological process and analysis of hydrological data required for design process.

Theory
UNIT-I: Introduction to heat and mass transfer and their analogous behaviour, steady and unsteady state heat conduction, analytical and numerical solution of unsteady state heat conduction equations, use of Gurnie-Lurie and Heisler Charts in solving heat conduction problems. Applications in food processing including freezing and thawing of foods.
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. Functional design of heat exchangers: Shell and tube, plate and scraped surface heat exchangers, Jacketed vessels.
UNIT-III: Radiation heat transfer and its governing laws, its applications in food processing.
UNIT-IV: Molecular diffusion in gases, liquids and solids; molecular diffusion in biological solutions and suspensions molecular diffusion in solids, unsteady state mass transfer and mass transfer coefficients, molecular diffusion with convection and chemical reaction, diffusion of gases in porous solids and capillaries, mass transfer applications in food processing.

Practical
Solving problems on steady and unsteady state conduction with or without generation; numerical analysis; problems in natural and forced convection; radiation; design of heat exchangers; performing experiments on heat conduction, convection and radiation heat transfer.

Suggested Readings

PFE 502/ FMPE 511
ENGINEERING PROPERTIES OF BIOLOGICAL MATERIALS

2+1
SEM - I

Objective
To acquaint and equip the students with different techniques of measurement of engineering properties and their importance in the design of processing equipments

Theory
UNIT-I: Physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Rheology; ASTM standard, terms, physical states of materials, classical ideal material, rheological models and equations, visco elasticity, creep-stress relaxation, Non Newtonian fluid and viscometry, rheological properties, force, deformation, stress, strain, elastic, plastic behaviour.
UNIT-II: Contact stresses between bodies, Hertz problems, firmness and hardness, mechanical damage, dead load and impact damage, vibration damage, friction, effect of load, sliding velocity, temperature, water film and surface roughness. Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials, aero dynamics of agricultural products, drag coefficients, terminal velocity.

UNIT-III: Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, methods of determination, steady state and transient heat flow. Electrical properties; Dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination, energy absorption from high-frequency electric field.

UNIT-IV: Preliminary design criteria of sprinkler and micro irrigation systems, hydraulics of sprinkler and micro irrigation systems. Design of lateral, submain and main line of sprinkler and micro irrigation. Fertigation aspects.

Practical
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, thermal properties like thermal conductivity, thermal diffusivity and specific heat, firmness and hardness of grain, fruits and stalk, electrical properties like dielectric constant, dielectric loss factor, loss tangent and A.C. conductivity of various food materials.

Suggested Readings

PFE 503 ADVANCED FOOD PROCESS ENGINEERING 2+1 SEM - II

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

Theory

UNIT-II: Non thermal processing: Microwave, irradiation, ohmic heating, pulsed electric field preservation, hydrostatic pressure technique etc


UNIT-IV: Extrusion: Theory, equipments, applications. Distillation and leaching: Phase equilibria, multistage calculations, equipments, solvent extraction.

Practical
Solving problems on single and multiple 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


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**PFE 504 FARM STRUCTURES AND ENVIRONMENTAL CONTROL**

**Objective**

To acquaint and equip the students with the techniques to control temperature, humidity and other composition of air to create favourable environment in the agricultural structures.

**Theory**

**UNIT-I**: Thermodynamic properties of moist air, psychrometric chart and computer programmes for thermodynamic properties.

**UNIT-II**: Farm structures, their design, constructional details and design of low cost structures; heating, ventilating and exhaust systems, air distribution and air cleaning, combustion of fuels and equipment.

**UNIT-III**: Drying and dehumidification system, air-water contact operations and evaporation, process and product air conditioning.

**UNIT-IV**: Instruments and measurements; codes and standards

**Practical**

Calculation of heating and cooling load; design calculation of moisture condensation in agricultural buildings; study of moisture migration behaviour in storage bins; design aspect of cold storage.

**Suggested Readings**


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**PFE 505/ FST 527 ENERGY MANAGEMENT IN FOOD PROCESSING INDUSTRIES**

**Objective**

To acquaint and equip the students with different energy management techniques including energy auditing of food industries.

**Theory**

**UNIT-I**: Energy forms and units, norms and scenario, basic principles & fundamentals of energy conservation, status of energy utilization for food processing in India & abroad and opportunities of energy conservation in food processing industries.

**UNIT-II**: Sources of energy, energy auditing, data collection, analysis and management in various operational units of the food processing industries, passive heating, passive cooling, sun drying and use of solar energy, biomass energy and other non-conventional energy sources in food processing industries.

**UNIT-III**: Cogeneration and waste heat recovery, reuse and calculation of used steam, hot water, chimney gases and cascading of energy sources. Energy accounting methods, measurement of energy, design of computer-based energy management systems, economics of energy use.
Practical
Study of energy use pattern in various processing units i.e., rice mills, sugar mills, dal mills, oil mills, milk plants, food industries etc. Energy audit study and management strategies in food processing plants. Identification of energy efficient processing machines. Assessment of energy consumption, production and its cost in food processing plants, visit to related food processing industry.

Suggested Readings

PFE 506 PROCESSING OF CEREALS, PULSES AND OILSEEDS 2+1 SEM - I

Objective
To acquaint and equip the students with the post harvest technology of cereals, pulses and oilseeds with special emphasis on their equipments.

Theory
UNIT-I: Production and utilization of cereals and pulses, grain structure of major cereals, pulses and oilseeds and their milling fractions; grain quality standards and physico-chemical methods for evaluation of quality of flours.
UNIT-II: Pre-milling treatments and their effects on milling quality; parboiling and drying, conventional, modern and integrated rice milling operations; wheat roller flour milling; processes for milling of corn, oats, barley, gram, pulses, paddy and flour milling equipments.
UNIT-IV: Packaging of processed products, design characteristics of milling equipments; selection, installation and their performance, BIS standards for various processed products

Practical
Physical properties of cereals and pulses, raw and milled products quality evaluations; parboiling and drying; terminal velocities of grains and their fractions; study of paddy, wheat, pulses and oilseeds milling equipments; planning and layout of various milling plants.

Suggested Readings

PFE 507 FOOD PROCESSING EQUIPMENT AND PLANT DESIGN 2+1 SEM - II

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

Theory
UNIT-I: Design considerations of processing agricultural and food products.
UNIT-II: Design of machinery for drying, milling, separation, grinding, mixing, evaporation, condensation, membrane separation.

UNIT-III: Human factors in design, selection of materials of construction and standard component, design standards and testing standards. Plant design concepts and general design considerations; plant location, location factors and their interaction with plant location, location theory models, computer aided selection of the location.


UNIT-V: Hygienic design aspects and worker’s safety, functional design of plant building and selection of building materials, estimation of capital investment, analysis of plant costs and profitabilities, management techniques in plant design including applications of network analysis, preparation of project report and its appraisal.

Practical
Detailed design and drawing of mechanical dryers, milling equipment, separators, evaporators, mixers and separators. Each individual student will be asked to select a food processing plant system and develop a plant design report which shall include 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

PFE 508 FRUITS AND VEGETABLES PROCESS 2+1 SEM - II ENGINEERING

Objective
To acquaint and equip the students with processing of fruits and vegetables and the design features of the equipments used for their processing.

Theory
UNIT-I: Importance of post harvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables.
UNIT-II: Harvesting and washing, pre-cooling, preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables
UNIT-III: Cold storage of fruits and vegetables, controlled atmosphere packaging of fruits and vegetables, gas composition, quality of storage.
UNIT-IV: Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.
UNIT-V: Intermediate moisture foods, ohmic heating, principle, high pressure processing of fruits and vegetables, applications sensory evaluation of fruit and vegetable products, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes.

Practical
Determination of size, shape, density, area-volume-mass relationship of fruits and vegetables, sugar-acid ratio of fruits, evaluation of washer, grader and packaging methods,
experiments on drying of fruits and vegetables, controlled atmosphere storage and quality evaluation.

Suggested Readings
Sumanbhatti & Uma Varma. 1995. Fruit and Vegetable Processing. CBS.

PFE 509 MEAT PROCESSING 2+1 SEM - II
Objective
To acquaint and equip the students with processing of meat and meat products and the design features of the equipments used for their processing.

Theory
UNIT-II: Slaughtering: Pre slaughter operations, post slaughter operations, wholesale and retail cuts.
UNIT-III: Preservation of poultry: different methods, stuffed products, frozen products, poultry concentrates and flavours, synthetic poultry flavour.
UNIT-IV: Different preservation methods of meat: Smoking, curing and freezing, chilling of meat and different methods of chilling, freezing of meat and different methods of freezing of meat, physical and chemical changes during chilling and freezing, packaging of meat and meat products, quality control.
UNIT-V: Classification, composition and nutritive value of eggs: Grading of eggs, different quality parameters of eggs, Haugh unit, processing of egg, yolk processing, egg breaking mechanisms, freezing of egg, pasteurization, desugarisation and dehydration of egg, different dehydration methods, quality control and specification of egg products.
UNIT-VI: Fish: Nutritional quality of fish and fish products, fillet and steaks, different preservation techniques, chilling, freezing, drying, canning, curing and smoking, quality control in fish processing.

Practical
Experiments in slaughtering, dressing, wholesale and retail cutting: Curing, preservation of meat and meat products, estimation of quality of egg, Haugh unit, de-sugarisation, preparation of whole egg powder, yolk powder, freezing of fish, drying of fish, canning of fish, visit to meat and fish processing units.

Suggested Readings
Chooksey MK. 2003. Fish Processing and Product Development. CIFE, Kochi.

PFE 510/ FST 505 FOOD PACKAGING 2+1 SEM - I
Objective
To acquaint and equip the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.

Theory
UNIT-I: Food containers: Rigid containers, glass, wooden boxes, crates, plywood and wire bound boxes, corrugated and fiber board boxes, textile and paper sacks, corrosion of containers (tin plate); Flexible packaging materials and their properties; Aluminum as packaging material; Evaluation of packaging material and package performance.

UNIT-III: Packaging equipments: Food packages, bags, types of pouches, wrappers, carton and other traditional package; Retortable pouches; Shelf life of packaged foodstuff.

UNIT-IV: Methods to extend shelf life; Packaging of perishables and processed foods; Special problems in packaging of food stuff. Different packaging system for (a) dehydrated foods, (b) frozen foods, (c) dairy products, (d) fresh fruits and vegetables, (e) meat, poultry and sea foods.

UNIT-V: Package standards and regulation; Shrink packaging; Aseptic packaging, CA and MAP, Active packaging; Biodegradable packaging.

Practical
Identification and testing of packaging materials; Determination of wax from wax paper; Testing of lacquered tin plate sheets; Measurement of tin coating weight by Clarke’s method; To perform sulphide stain test; To conduct ferricyanide paper test for porosity; Determination of equilibrium moisture content; Grading of glass bottles for alkalinity; Determination of water vapour transmission rate of packaging material; To perform vacuum packaging of food sample and carry out its storage study; Testing compression strength of the boxes; Packaging the food material in seal and shrink packaging machine and study its shelf life; Testing the strength of glass containers by thermal shock test; Testing the strength of filled pouches by drop tester.

Suggested Readings

PFE 511 FOOD QUALITY AND SAFETY ENGINEERING 2+1 SEM - 1

Objective
To acquaint and equip the students with the latest standards to maintain food quality as well as to study HACCP protocol.

Theory
UNIT-I: Food safety, need for quality control and safety, strategy and criteria, microbiological criteria for safety and quality, scope of food toxicology, toxic potential and food toxicants, biological and chemical contaminants.
UNIT-II: Food additives and derived substances, factors affecting toxicity, designing safety in products and processes, intrinsic factors, establishing a safe raw material supply, safe and achievable shelf life.
UNIT-III: Process equipment and machinery auditing, consideration of risk, environmental consideration, mechanical quality control.
UNIT-IV: Personnel hygienic standards, preventative pest control, cleaning and disinfecting system, biological factors underlying food safety.
UNIT-V: Preservation and stability, contaminants of processed foods, adulteration, prevention and control, FPO, PFA, Codex, GMP, BIS and HACCP; Practices, principles, standards, specifications, application establishment and implementation; HACCP and quality management system.

Practical
Microbiological examination of food, hazard analysis, premises design, HACCP project plan; CCP, CCP Decision tree, HACCP control chart. HACCP case studies; Survey, BIS, FPO, Codex standards and specifications. Visits to food industries to study the various quality and safety aspects adopted.

Suggested Readings


**PFE 512 BIOCHEMICAL AND PROCESS ENGINEERING 2+1 SEM - II**

**Objective**

To acquaint and equip the students with the basic principles of biochemical and process engineering.

**Theory**

UNIT-I: Applications of engineering principles; mass and energy balance, fluid flow principles, unit operations of process engineering.

UNIT-II: Fundamentals of growth kinetics, maintenance energy and yield concepts, principles of media sterilization, media formulations of industrial fermentation.

UNIT-III: Aerobic and agitated rheology of fermentative fluids, design and scale-up of bioreactors, enzyme reactors.

UNIT-IV: Watershed management research instrumentation and measurement, problem identification, simulation and synthesis.

UNIT-V: Principles of recovery of fermented products in bio-processing, instrumentation, transport phenomenon.

**Practical**

Kinetics of one substitute reactions, kinetics of growth in batch cultures, design consideration for bioreactors, media preparation and sterilization, microprocessor based monitoring of bioprocess parameters.

**Suggested Readings**


**PFE 513 STORAGE ENGINEERING AND HANDLING 2+1 SEM - II OF AGRICULTURAL PRODUCTS**

**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 of grains, biochemical changes during storage, production, distribution and storage capacity estimate models, storage capacity models, ecology, storage factors affecting losses, storage requirements.

UNIT-II: Bag and bulk storage, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products, function, structural and thermal design of structures, aeration system.

UNIT-III: Grain markets, cold storage, controlled and modified atmosphere storage, effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities, irradiation, storage of dehydrated products, food spoilage and preservation, BIS standards.

UNIT-IV: Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts; design of belt, chain, screw, roller, pneumatic conveyors and bucket elevators; principles of fluidization; recent advances in handling of food materials.

**Practical**

Quality evaluation of stored products, design of storage structures, cold storage, load estimation, construction, maintenance, static pressure drop, experiment on controlled and
modified atmosphere storage system, estimation of storage loss, and quality of stored products.

**Suggested Readings**

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


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**PFE 514/ SST 507**

**SEED DRYING, PROCESSING & STORAGE 2+1 SEM - II**

**Objective**

To acquaint the students with drying and processing of seeds, operation and maintenance of different seed processing machinery & dryers

**Theory**

UNIT-I: Principles and importance of seed processing, preparation of seeds before processing, machines used to prepare seed for processing (Delinters, extractors, debearder, sacrificer etc.)

UNIT-II: Operation maintenance of different seed processing machinery such as air screen cleaner, indented cylinder, disc separator, gravity separator, pneumatic separator, surface texture equipment, shape sizing, colour sorter, magnetic separator, electrostatic separator, seed conveying, different types of conveyers, Seed treating, and treaters.

UNIT-III: Seed drying principles and methods, E.M.C. Theory of drying, calculation of drying time, different types of heated air dryers, importance of scientific seed storage, types of storage structures, methods of maintaining safe seed moisture, thumb rule and its relevance, management and operation/ cleanliness of seed store, design features of medium and long term seed storage structures.

UNIT-IV: Seed packaging, principles, practices, materials weighing and bagging machines, their operation and maintenance, seed quality maintenance during processing. Plant design and lay out, safety considerations in plant design.

**Practical**

Operation and performance evaluation of various seed processing equipments such as pre cleaner, scalpers, air screen cleaner, indented cylinder, gravity separator, pneumatic separator, colour sorter and other equipments, seed treater, conveyors and elevators, bag closers, different types of dryers, design and layout of seed processing plant and its economics, analysis of cost of operation and processing, determination of seed moisture, seed germination and vigour.

**Suggested Readings**


**PFE 592**

**SPECIAL PROBLEM 0+1 SEM - I, II**

**PFE 595**

**INDUSTRY/ INSTITUTE TRAINING 0+1 (NC) SEM - I, II**

*(Minimum of 3 weeks training)*

**Objective**

To expose the students to the industry

**Practical**

In-plant training in the relevant food industry during processing operation of the plant to study the actual working of the equipment and various unit operations. The evaluation will
be based on the written report of the student and the comments of the factory managers. The duration of training shall be three weeks. The student shall be required to do training in the institute other than the institute in which he/she is enrolled.
PROCESSING AND FOOD ENGINEERING

List of Journals

- Agricultural Mechanization in Asia, Africa and Latin America
- Indian Food Industry, India
- Journal of Agricultural Engineering Research, UK
- Journal of Agricultural Engineering, India
- Journal of Food Engineering
- Journal of Food Science
- Journal of Food Science and Technology, India
- Packaging India, India
- Transaction of American Society of Agricultural Engineers

Suggested Broad Topics for Master’s Research

- Controlled atmosphere storage and modified atmosphere packaging
- Development of crop specific post harvest techniques for reduction in quantitative and qualitative losses to farm produce
- Design and development of need based, demand driven technologies for reduction in post harvest losses to farm produce, livestock and horticultural produce
- Development of post harvest processes and equipment for value addition to farm produce
- Development of processes and equipment for better utilization of agricultural residues and by-products
- Packaging of fresh and processed foods
- Drying and dehydration of grains, fruits, vegetables and dairy products
- Engineering properties of food materials
# SOIL AND WATER ENGINEERING

## Course Structure

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* Compulsory for master’s programme; †Courses open for students of other Departments
SOIL AND WATER ENGINEERING
Course Contents

SWE 501 WATERSHED HYDROLOGY 2+1 SEM - I

Objective
To acquaint and equip students about hydrological process and analysis of hydrological data required for design process.

Theory
UNIT-I: Hydrologic process and systems; Hydrologic problems of small watershed; Hydrologic characteristics of watershed.
UNIT-II: Measurement and analysis of hydrologic parameters, rainfall-runoff models, stream flow measurement and analysis of data
UNIT-III: Hydrograph analysis; Unit hydrograph theory; Synthetic and dimension less hydrograph, convolution of unit hydrograph.
UNIT-IV: Concept of hydraulic flood routing, flood routing (reservoir and channel routing).
UNIT-V: Definition and concept of different types of hydrologic models for simulation of hydrologic problems.

Practical
Rainfall analysis, runoff computation, construction of hydrographs, delineation of watershed, hydrograph analysis, reservoir and channel routing, hydrologic models, visit to dam sites.

Suggested Readings

SWE 502 DESIGN OF FARM IRRIGATION SYSTEMS 2+1 SEM - I

Objective
To acquaint and equip students with the irrigation principles, design consideration of surface irrigation and micro irrigation systems and their evaluation.

Theory
UNIT-I: Concepts of Irrigation; Irrigation principles, losses, conveyance, distribution; Application, scheduling parameters, water budgeting.
UNIT-II: Surface irrigation, hydraulics of water advance and recession, hydraulic resistance to flow, gravity irrigation.
UNIT-III: Design of Border irrigation, furrow irrigation, check basin irrigation; Sub Irrigation methods and concepts.
UNIT-IV: Preliminary design criteria of sprinkler and micro irrigation systems, hydraulics of sprinkler and micro irrigation systems. Design of lateral, submain and main line of sprinkler and micro irrigation. Fertigation aspects.
UNIT-V: Underground water conveyance system; Evaluation of irrigation systems and practices.

Practical
Design and evaluation of border, furrow, check basin, sprinkler and micro irrigation, computation of frictional losses, design of underground water conveyance systems, economics of irrigation methods, visit to mechanized farms.

Suggested Readings
Pillsbury AF. 1972. Sprinkler Irrigation. FAO Agricultural Development Paper No. 88, FAO.
SWE 503  AGRICULTURAL DRAINAGE SYSTEMS  2+1  SEM - II

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

Theory
UNIT-I: Theories and applications of surface and sub-surface drainage, steady state, unsteady state drainage equations for layered and non-layered soils, horizontal sub-surface drainage.
UNIT-II: Principle and applications of Ernst, Glover Dumm, Kraijenhoff-van-de Leur equations.
UNIT-III: Salt balance, leaching requirement and management practices under drained conditions
UNIT-IV: Design of different components of sub-surface drainage systems, theories of vertical drainage and multiple well point system.
UNIT-V: Disposal of drainage effluents, Management of drainage projects of waterlogged and saline soils, case studies.

Practical
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 Reading

SWE 504  GROUNDWATER ENGINEERING  2+1  SEM - II

Objective
To acquaint and equip students with the occurrence, development and hydraulics of groundwater flow.

Theory
UNIT-I: Properties affecting groundwater storage and movement, groundwater balance studies.
UNIT-IV: Groundwater modeling for water resources planning.
UNIT-V: Techniques for groundwater recharge.

Practical
Water table contour maps and determination of groundwater flow, estimation of aquifer characteristics, problems on non leaky and leaky aquifers, analysis of pumping test data; Computation of interference of wells; groundwater computer simulation models.

Suggested Readings
SWE 505  
**SOIL AND WATER CONSERVATION ENGINEERING  2+1  SEM - I**

**Objective**
To acquaint and equip students with the process of degradation of soil and water resources and their remedial measures including design of structures.

**Theory**
- **UNIT-I**: Probability and continuous frequency distribution; Fitting empirical distributions.
- **UNIT-II**: Layout and planning of soil and water conservation measures; Design principles of soil and water conservation structures including contour bunds and terraces; Gully control measures.
- **UNIT-III**: Hydraulic jump and energy dissipaters for soil conservation structures; Hydrologic, hydraulic and structural design of drop structures.
- **UNIT-IV**: Sediment deposition process. Estimation of sediment load, earthen dams, seepage through dams and stability analysis.
- **UNIT-V**: Rainwater harvesting, Flood control and stream bank protection measures.

**Practical**
Design of drop spillway, chute spillway, drop inlet spillway, hydraulic jump calculation, design of bench terrace, contour bunds and contour trenches, design and problems on earthen dam, silt detention tanks and check dams, visit to soil conservation structures sites.

**Suggested Readings**

SWE 506  
**CROP ENVIRONMENTAL ENGINEERING  2+0  SEM - II**

**Objective**
To acquaint and equip students with the process of soil-water-plant relationship and their interaction for crop growth.

**Theory**
- **UNIT-I**: Aerial and edaphic environments for plant growth, energy and mass transfer in and above crop canopies.
- **UNIT-II**: Climatic changes and plant response to environmental stresses, evapotranspiration models. Instrumentation and techniques for monitoring plant environments.
- **UNIT-III**: Processes and aspects of growth and development, soil-root interface, root sink functions.
- **UNIT-IV**: Water movement in soil-plant atmosphere continuum, artificial environments and plant behaviour.
- **UNIT-V**: Design and operation of controlled environment facilities and their instrumentation. Crop growth and yield modeling.

**Suggested Readings**

SWE 507  
**DESIGN OF PUMPS FOR IRRIGATION AND DRAINAGE  2+0  SEM - I**

**Objective**
To acquaint and equip students with requirement of pumps for irrigation and drainage system and their design features.

**Theory**
- **UNIT-I**: Basic hydraulic design of centrifugal pump, water hammer problem in centrifugal pump.
- **UNIT-II**: Principle and performance characteristics of vertical turbine pump, submersible pump and axial flow pump and their design.
UNIT-III: Non-conventional energy sources for pumping, wind mills, micro turbines, solar pumps, hydraulic ram- their selection and design criteria.


Suggested Readings


**SWE 508**

**OPEN CHANNEL FLOW**

**3+0**

**SEM - II**

**Objective**

To acquaint and equip students with the hydraulics of surface water flow phenomenon in open channels.

**Theory**

UNIT-I: Open channel and their properties, energy and momentum, critical flow computation and application.

UNIT-II: Uniform flow; gradually varied flow theory and analysis, methods of computation.

UNIT-III: Practical problems such as design of transitions, flow passing Islands etc. spatially varied flow, rapidly varied flow.

UNIT-IV: Hydraulic jump and its use as energy dissipator, flow through channel of non-linear alignment and flow through non-prismatic channel sections.

UNIT-V: Unsteady flow, gradually varied unsteady flow and rapidly varied unsteady flow.

**Suggested Readings**


**SWE 509**

**FLOW THROUGH POROUS MEDIA**

**2+0**

**SEM - I**

**Objective**

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

**Theory**

UNIT-I: Aquifer and fluid properties, forces holding water in soils, hydrodynamics in porous media and limitations of governing laws.

UNIT-II: Differential equations of saturated flow, initial and boundary conditions. Dupuit and Boussinesq approximations and linearization techniques.


**Suggested Readings**


**SWE 510**

**WATER RESOURCES SYSTEM ENGINEERING**

**3+0**

**SEM - II**

**Objective**

To acquaint and equip students with the techniques for optimization of water resources for achieving maximum output.

**Theory**
UNIT-I: Concepts and significance of optimization in water resources, objective functions, deterministic and stochastic inputs.
UNIT-II: Mathematical programming techniques, linear programming and its extension: gradient method, simplex method, non-linear programming classical optimization.
UNIT-III: Geometric programming and dynamic programming, application of optimization techniques for water resources.
UNIT-IV: Development and management including conjunctive use, crop production functions and irrigation optimization.

**Suggested Readings**

**SWE 511 GIS AND REMOTE SENSING FOR LAND AND WATER RESOURCES MANAGEMENT**

**Objective**
To acquaint and equip with the techniques of Remote Sensing and application of GIS for land and water resources management.

**Theory**
UNIT-I: Basic principles of remote sensing and sensors. Elements of photogrametry.
UNIT-IV: Importance of ground truth establishment, GIS and remote sensing for land and water resources data collection, analysis and interpretation. Application of GIS in water and land resource development and management.

**Practical**
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. Use of GIS packages.

**Suggested Readings**

**SWE 512 WATERSHED MANAGEMENT AND MODELING**

**Objective**
To acquaint and equip the students with the watershed management modeling and modeling systems.

**Theory**
UNIT-II: Survey, monitoring, reclamation and conservation of agricultural and forest lands, hill slopes and ravines.
UNIT-IV: Watershed management research instrumentation and measurement, problem identification, simulation and synthesis.
UNIT-V: Modeling of flood and drought phenomenon, drought management and dry farming.

**Practical**

**Suggested Readings**
SWE 513 LAND DEVELOPMENT AND EARTH MOVING MACHINERY 2+0 SEM - I

Objective
To acquaint and equip the students with the Land Development and Earth Moving Machinery.

Theory
UNIT-I: Objectives, methods and equipment for land clearing and development. Machinery selection, based on mechanics of operation and vegetation types.
UNIT-IV: Boring machines. Different methods of boring.

Suggested Readings

SWE 592 SPECIAL PROBLEM 0+1 SEM - I, II

Objective
Identification, planning and formulation of the problem, review of literature, report preparation and presentation.

SWE 595 INDUSTRY/INSTITUTE TRAINING 0+1(NC) SEM - I, II

Objective
To expose the students to the industry.

Practical
In plant training in the relevant industry/institution related to Soil and Water Engineering field. The evaluation will be based on the written report of the student and the comments of the factory managers. The duration of training shall be three weeks. The student shall be required to do training in the institute other than the institute in which he/she is enrolled.
SOIL AND WATER ENGINEERING

List of Journals

- Agricultural Water Management
- Ground Water
- Irrigation and Drainage (ICID)
- Journal of Hydrology
- Journal of Soil Conservation
- Journal of Water Management
- Transactions of ASABE
- Transactions of ASCE
- Water Resource Research

Suggested Broad Topics for Master’s Research

- Groundwater modeling
- Hydrologic modeling of watersheds
- Conjunctive use of surface and groundwater
- Design and evaluation of irrigation and drainage systems and soil conservation measures
- Rainfall runoff modeling
- Evaluation of canal command area
- Water productivity analysis
- Water and energy saving technologies
- Application of modern tools such as Remote Sensing, GIS and simulation modeling for soil and water management strategies
### BASIC ENGINEERING

#### Course Structure

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To be taught by: 1 Basic Engineering (CE) and Farm Machinery & Power Engineering; 2 Basic Engineering (CE and EE)
BASIC ENGINEERING

Course Contents

CIVIL ENGINEERING

CE 501  ADVANCED SURVEYING  2+1  SEM - I

Objective
To acquaint students with the principles and methods of land hydrographic and aerial survey on par with global standards.

Theory
UNIT-I: Contouring: Methods of contouring; Interpolation of contours; Use of contours maps; drawing L section and cross-section from contour maps; Tracing contour gradient for alignment of roads and canal etc; finding volume of earth-work and capacity of reservoir from contour map. Use of total station.
UNIT-II: Hydrographic Surveying: Control - Shore line - River surveys - Soundings gauges - Signals - Sextant - Methods of locating soundings.
UNIT-III: Modern Surveying: Aerial Surveying and Ground Photogrammetry: Elementary knowledge of both with the basic principles involved especially of stereoscopic vision and interpretation. Advantages of aerial surveying over conventional methods.

Practical
To find Reduced levels and horizontal distances using theodolite as a Tacheometer. Study and use of Total Station for measurement of Horizontal and Vertical angles. Use of Total Station for finding horizontal and vertical distances and reduced levels. Determine the geometrical parameters by total station. Stereoscopic vision and interpretation.

Suggested Readings:
Mart CA. Air Photography Applied to Surveys.
Moffitt FH. Photogrammetry.
Natarajan V. Advanced Surveying. BI Publ., New Delhi.
Shahani PB. Advanced Surveying. Oxford & IBH.
Subramanian R. Surveying and Levelling.

CE 502  DESIGN OF DAMS AND RESERVOIR  3+1  SEM - II

Objective
To acquaint and equip with different types of dams, their design philosophies and use.

Theory
UNIT-I: Dams classification. Suitable site selection for dams and reservoirs. Survey and planning of storage projects.
UNIT-V: Spill way and spillway capacities and spillway gates.
UNIT-VI: Reservoir planning, Storage, sedimentation, Losses, Economics. Flood routing.

Practical
Exercises on design of concrete and earthen dams, problems on seepage through dams.

Suggested Readings
CE 503  WATER QUALITY AND POLLUTION CONTROL  3+1  SEM - I

Objective
To acquaint and equip with different aspects of wastes and waste water quality, treatment and their importance.

Theory
UNIT-I: Impurities in water. Water analysis (Physical, Chemical and Bacteriological).
UNIT-II: Indices of water quality for domestic and industrial uses. Monitoring of water quality from various sources of water pollution.
UNIT-III: Purification of water supplies.
UNIT-IV: Waste water characteristics and disposal methods.
UNIT-VI: Mathematical modeling on pollution control. Environmental legislation on water pollution in India and abroad.

Practical
Determination of pH, dissolved and suspended solids, Chlorides, Sulphates, turbidity, dissolved oxygen hardness, BOD, COD, Nitrogen (Ammonical, nitrate, nitrite), MPN, Total count of bacteria in water/sewage samples.

Suggested Readings

CE 504  FLUVIAL HYDRAULICS  2+1  SEM - II

Objective
To acquaint and equip the students with different aspects of Fluvial Hydraulics and their importance in engineering.

Theory
UNIT-I: Sediment properties, Sediment problems. Incipient motion of sediment particles.
UNIT-II: Regimes of flow. Resistance to flow.

Practical
Problems on determination of sediment properties, regimes of flow, resistance to flow, incipient motion, bed load, suspended load, total load transport and sediment transport.

Suggested Readings

CE 505 / FPME 505
APPLIED INSTRUMENTATION IN FARM  2+1  SEM - I
MACHINERY AND STRESS ANALYSIS
(To be taught jointly by Civil Engineering and Farm Machinery & Power Engineering)

Objective
To acquaint and equip with the concept of instrumentation used in farm power and machinery and measuring devices for force, torque and other parameters.

Theory
UNIT-I: Strain and stress, strain relationship, strain gauges. Mechanical, optical, electrical acoustical and pneumatic etc. and their use. Various methods of determining strain/stresses experimentally. Measuring devices for displacement (linear and rotational),
velocity, force, torque and shaft power. Strain gauges: types and their application in two and three dimensional force measurement. Design and analysis of strain gauges.

UNIT-II: Introduction to functional elements of instruments. Active and passive transducers, Analog and digital modes, Null and deflection methods. Performance characteristics of instruments including static and dynamic characteristics.


UNIT-IV: Basic signal conditioning devices - data acquisition system – micro computers for measurement and data acquisition. Data storage and their application.

Practical
Calibration of instruments, Experiment on LVDT, strain gauge transducer, inductive and capacitive pick ups, speed measurement using optical devices, vibration measurement exercises , making of thermocouples and their testing- basic electronic circuits and application of linear ICs.

Suggested Readings

CE 506 SIMILITUDE IN ENGINEERING 2+1 SEM - II

Objective
To acquaint and equip the students with different aspects of similitude in Engineering and its importance in engineering.

Theory
UNIT-I: Dimensions and units.
UNIT-II: Dimensional and similarity analysis. Theory of models.
UNIT-III: True, distorted and dissimilar models.
UNIT-IV: Application to different systems with special reference to Structural and fluid flow systems, Analogues.

Practical

Suggested Readings

CE 507 SOLID WASTES MANAGEMENT 2+0 SEM - I

Objective
To acquaint and equip the students with different methods for management of solid wastes and their importance.

Theory
UNIT-I: Definition. Sources. Quality, Classification and characteristics of solid waste collection, Transport and reduction at source.
UNIT-II: Handling, Collection , Storage, transport of Solid wastes.
UNIT-III: Disposal methods and their merits and demerits.
UNIT-IV: Processing of solid wastes. Fertilizers, fuel and food values.
UNIT-V: Recycling and reuse materials and energy recovery operations.

Suggested Readings
CE 508  DESIGN OF BINS AND SILOS  2+1  SEM - II

Objective
To acquaint and equip the students with Design practices for optimum design of grains storage structures.

Theory
UNIT-I: Computer aided design manuals. Rankine’s and Coloumb’s theories of active and passive pressures.
UNIT-II: Janssen’s and Airy’s theories grain pressure theories for design of deep and shallow silos. Reimbert’s theory of silo design.
UNIT-III: Comparison of Australian (AS) and Indian (BIS) design criteria for bins and silos.
UNIT-IV: Computer aided design of grain silos by developing flowcharts and programs for underground and over ground silos.

Practical
Analysis and design of silos of various capacities using available software. Use of different standard codes and theories in the development of flowcharts and design program for various capacity silos.

Suggested Readings

CE 509  RANDOM VIBRATIONS  2+0  SEM - I

Objective
To acquaint and equip the students with design by linear and nonlinear random loading analysis.

Theory
UNIT-I: Response to linear single and multi-degree of freedom system to stationary and non-stationary random excitation.
UNIT-II: Response of continuous systems. Normal mode method.
UNIT-IV: Applications to mechanical, aero, civil, ocean and agricultural engineering systems.

Suggested Readings

CE 510  PROBABILISTIC APPROACH IN DESIGN  2+0  SEM - II

Objective
To acquaint and equip the students with different probabilistic methods for dynamic loading design.

Theory
UNIT-I: Review of various approaches in engineering design and introduction of probabilistic approach.
UNIT-II: Random variables. Probability distribution and density functions. expected values, Mean, Variance, Conditional probability. Characteristic functions.
Suggested Readings

CE 511/ FST 526 WASTE RECYCLING AND RESOURCE RECOVERY SYSTEM 2+1 SEM - II
(To be taught jointly by Civil Engineering and Food Science & Technology)

Objective
To acquaint with importance of food wastes for resource generation. To familiar with various technologies for recycling of waste.

Theory
UNIT-I: Waste & its consequences in pollution and global warming, Types of food processing wastes & their present disposal methods.
UNIT-II: Treatment of plant waste by physical, chemical and biological methods, Effluent treatment plants, Use of waste and waste water.
UNIT-III: Types, availability and utilization of by-products of cereals, legumes & oilseeds, Utilization of by-products from fruits and vegetables processing industries, sugar and agro based industries, and brewery & distillery waste.
UNIT-IV: Status and utilization of dairy by-products i.e. whey, buttermilk and ghee residues, Availability & utilization of by-products of meat industry, poultry industry and fish processing units.
UNIT-V: Biomethanation and biocomposting technology for organic waste utilization, incineration & efficient combustion technology, Integration of new and renewable energy sources for waste utilization.

Practical
Study of waste utilisation processes; Various treatments in use for waste disposal; Study on operational precautions; Extraction of volatile oils from organic waste; Use of crop residue for the production of cellulose; Use of mango kernels for manufacturing of starch; Production of pectin from organic waste. Preparation of design of sewage treatment plants.

Suggested Readings

CE 512/ EE 505/ FST 453 GENERAL ENGINEERING PRINCIPLES 2+1 SEM - I
(To be taught jointly by Basic Engineering - CE, EE)

Objective
To acquaint with basic principle of General Engineering required for food processing. To familiarize with techniques for process heat and their availability.

Theory
UNIT-III: Alternators - Elementary principles and different types of alternators; E.M.F. in alternators, circuit breakers; Induction motors – Fundamental principles, production of rotating fields, construction; Rotor winding squirrel cage and phase wound rotors; Analysis of current and torque; starting of induction motors, motor housing, selection of motor and its controls.

Practical
Study of voltage resonance in L.C.R. circuits at constant frequency; (a) Star connection-study of voltage and current relation (b) Delta connection-study of voltage and current relation; Measurement of power in 3-phase circuit; (a) For balanced loads (b) For unbalanced loads, by wattmeter and energy meters; Polarity test, no-load test, efficiency and regulation test of single phase; Voltage and current relation in a 3-phase transformer of various kinds of primary and secondary connection systems; Test on 3-phase induction motor. Tests on various construction materials, study of drawings and various symbols.

Suggested Readings
Thereja BL. Electrical Machines.

ELECTRICAL, ELECTRONICS AND COMPUTER ENGINEERING

EE 501 ADVANCED INSTRUMENTATION 2+1 SEM - I

Objective
To acquaint and equip the students with various types of transducers for study and analysis of various variables.

Theory
UNIT-III: Temperature measurement using Bi-metals, PTRs, Thermistors, Thermocouples, Electronic IC sensors and Pyrometers. Heat flux measurement. Humidity measurement – Dry and Wet bulb, Hair hygrometer and Humister. Soil and Grain moisture transducers, pressure measurement – Manometers, Bourdon Tube, Diaphragm type transducer. High pressure and vacuum sensing techniques.
UNIT-V: Level measurement, OD and pH measurement, PCO2 and grain quality measurement. Biomedical measurement – BP, ECG etc., Ultrasonic flaw detection, Spectroscopy.

Practical
Study the characteristics of various transducers: Potentiometer, LVDT, Proximity sensors and Photo pickups, Load cell, Thermistor and Thermocouple, LM 335/AD 590ae of various Analog interfacing blocks: Attenuators, Amplifiers, A/D converters, Filters, digital interfaces using Wave shapers and level shifters. Practice of using interfaces and developing suitable software for data acquisition through PC/Microcomputer: Use of Microcomputer kit, Study the use of 8255 I/O IC, Study the use of printer port in a PC. Data acquisition through PC/Kit.

Suggested Readings
EE 502 \hspace{1cm} \textbf{PROCESS CONTROL SYSTEMS} \hspace{1cm} 2+1 \hspace{1cm} \text{SEM - II}

\textbf{Objective}

To acquaint and equip the students about the concepts involved in process control system to control variables at the desired level.

\textbf{Theory}

UNIT-I: Introduction to Process Control - Controlled Variable, Control strategy, Single Variable and multi variable control systems, Process Control loop, Open loop and closed loop control system, Linear and non linear control system, Transfer function and procedure for determining the Transfer function of Complex Control System, Representation of a Control System by block diagram and its Reduction


UNIT-III: Improved Control through Complex Control of process - Controller Modes or actions, On/OFF Mode, Proportional Mode, Integral Mode, Derivative Mode, Composite Control Mode (PD, PI, PID, Modes).

UNIT-IV: Analysis of Common loop, involving - Flow control (Solid, liquid and gaseous flow), Pressure regulation (Pressure Transducers), Liquid level (Mechanical & Electrical Systems), Temperature Control (Thermistor and thermocouple).

UNIT-V: Introduction to Computer Control of Process Application and design - Signal Conditioning, Design of OP AMPS circuits used to implement Proportional, Integral, Derivative and Composite Modes. Study of various computer Controlled Electrical and Mechanical Systems.

\textbf{Practical}

Study of various controllers by using Op-Amps, Use of microprocessors in process control.

\textbf{Suggested Readings}


Manke BS. 2006. \textit{Linear Control System}. Khanna Publ.

EE 503 \hspace{1cm} \textbf{COMPUTER GRAPHICS} \hspace{1cm} 2+1 \hspace{1cm} \text{SEM - I}

\textbf{Objective}

To acquaint and equip the students with the under lined concepts for generating various geometrical shapes and processing them.

\textbf{Theory}

UNIT-I: Graphic display devices, interactive devices, line and circle plotting techniques by using Bresenham’s algorithm, windowing and clipping, Sutherland Cophen algorithm, Cyrus and Beck method.

UNIT-II: Curve drawing using Hermite polynomial, Bezier curve, B splines, picture transformation, translation, rotation, scaling and mirroring


UNIT-IV: Orthogonal projection and multiple views, isometric projection, perspective projection, 3D clipping


\textbf{Practical}

Practices on 2-D and 3-D, drawings using AUTOCAD software.

\textbf{Suggested Readings}


Objective
To acquaint and equip the students about the concepts of neural network for solving engineering problems.

Theory
UNIT-I: Introduction to neural network and its comparison with biological system. Perceptron and linear separable functions, multi-layers perceptrons.
UNIT-II: Back propagation, one basic learning algorithm for feed-forward neural network, variation and improvement for back-propagation algorithm, Generalisation of learning algorithm.
UNIT-IV: Unsupervised learning and self organized features maps.
UNIT-V: Application of neural network in function approximation, time series predictions, pattern recognition, control systems and optimization in engineering problems.

Practical
Development of neural network by back-propagation learning algorithm using MATLAB for function approximation, time series predictions, pattern recognition, control systems and optimization in engineering problems.

Suggested Readings

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Objective
To acquaint and equip the students with important area for analysis and design of Farm Machinery Mechanism.

Theory
UNIT-I: Introduction to kinematics of mechanisms, kinematic analysis and synthesis, mobility and degree of freedom of a mechanism, systematics of mechanisms deriving other mechanisms from linkages.
UNIT-II: Relative motion, instantaneous center method, Kennedy’s theorem. Graphical and analytical methods of displacement, velocity and acceleration analysis, Computer – Aided analysis of mechanisms.
UNIT-IV: Kinematics of gears-Analysis of epicyclic gear trains. Synthesis of gear trainscompound and epicyclic. Cam – follower system; standard follower motions and combinations, importance of follower acceleration in cam system dynamics, terms related to cam design- their importance. Cam synthesis – graphical cam profile layout for a desired follower motion. Analytical determination of cam profile co-ordinates for disc cam operating common types of follower.

Suggested Readings
ME 502  VIBRATION ANALYSIS  3+0  SEM - II

Objective
To acquaint and equip the students with Significant field in the study and Analysis of farm machinery dynamics.

Theory

Suggested Readings

ME 503  ADVANCED MACHINE DESIGN  3+0  SEM - I

Objective
To acquaint and equip the students with advanced design of machine components, fatigue analysis and optimum design.

Theory
UNIT-II: Endurance limit of metals, low cycle fatigue and cumulative fatigue damage. Fatigue testing and presentation of fatigue data, correlation between fatigue limit and ultimate strength of materials.
UNIT-III: Optimum system design of machine components (Springs, gears, linkages, shells, plates, and pressure vessels).
UNIT-V: Failure analysis of various machine components, matrix method of design.

Suggested Readings

ME 504  THEORY OF INTERNAL COMBUSTION  3+0  SEM - II

ENGINE

Objective
To acquaint and equip the students with various thermodynamic laws, and functioning of fuel combustion systems and IC engines.

Theory
UNIT-I: Basic laws of thermodynamics, availability concept. Gibbs Holmholtz functions of energy, ideal and actual cycle analysis, irreversible thermal process and its applications.
UNIT-II: Heat balance sheet for 2-stroke and 4-stroke cycle engines, calculations of air-fuel ratios in carburetors, fuel and combustion, ignition delay and theory of detonation and its control.


UNIT-IV: Theory of cooling and lubrication, supercharging types and methods for improving design, design of smokeless engines.

Suggested Readings