

Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Undergraduate program
B. Tech. Agricultural Engineering
w.e.f. Session 2019-20

Semester – VII

| Course Code | Subject | Periods per week | | | Evaluation Scheme Theory Mid Sem | | | Evaluation Scheme Practical Mid Sem | | | End Sem Practical Exam | Sub Total (Sessional + Practical Exam) | End Sem Theory Exam | Subject total | Credit | Total Credit Points |
|--------------------------|--|------------------|---|----|----------------------------------|----|-------|-------------------------------------|----|-------|------------------------|--|---------------------|---------------|--------|---------------------|
| | | L | T | P | CT | TA | Total | CT | TA | Total | | | | | | |
| AE401 | Project | 0 | 0 | 12 | - | - | - | 5 | 5 | 10 | 90 | 100 | - | 100 | 0:0:6 | 6 |
| AE402 | Seminar | 0 | 0 | 2 | - | - | - | 5 | 5 | 10 | 90 | 100 | - | 100 | 0:0:1 | 1 |
| <i>Elective Courses*</i> | | | | | | | | | | | | | | | | |
| AE403 | Food Packaging Technology | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE404 | Design & Maintenance of Green House | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE405 | Waste and By-product Utilization | 1 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 1:0:1 | 2 |
| AE406 | Development of Processed Products & Equipments | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE407 | Food Processing Plant Design & Layout | 1 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 1:0:1 | 2 |
| AE408 | Micro Irrigation Systems Design | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE409 | Watershed Planning and Management | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE410 | Minor Irrigation & Command Area Development | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE411 | Environmental Engg. | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE412 | Gulley & Ravine Control Structures | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE413 | Remote Sensing & GIS Applications | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE414 | Reservoir & Farm Pond Designing | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE415 | Tractor Design & Testing | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE416 | Hydraulic Drive & Controls | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE417 | Farm Power & Machinery | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |

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|--------------|---|---|---|---|----|----|-----------|---|---|-----------|-----------|-----------|----|------------|-------|----------------------|
| | Management | | | | | | | | | | | | | | | |
| AE418 | Renewable Energy Technology | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE419 | Human Engg. & Safety 2 | 1 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 1:0:1 | 2 |
| AE420 | Biomass Management for Fodder & Energy | 1 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 1:0:1 | 2 |
| AE421 | Production Technology of Agril. Machinery | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE422 | Mechanics of Tillage and Traction | 2 | 0 | 2 | 10 | 10 | 20 | 5 | 5 | 10 | 20 | 50 | 50 | 100 | 2:0:1 | 3 |
| AE423 | System Engineering | 3 | 0 | 0 | 10 | 10 | 20 | - | - | - | - | 20 | 80 | 100 | 2:0:1 | 3 |
| | Total | | | | | | | | | | | | | | | 7+15* =22 |

**Student can offer a minimum of 15 credits from elective courses.*

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Food Packaging Technology
Paper Code: AE403
w.e.f. Session 2019-20

3 (2+1)

Theory

Unit-1.

Factors affecting shelf life of food material during storage; spoilage mechanism during storage; definition, requirement, importance and scope of packaging of foods; types and classification of packaging system; advantage of modern packaging system.

Unit-2.

Different types of packaging materials used. Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink packaging, vacuum & gas packaging. Packaging requirement & their selection for the raw & processed foods.

Unit-3.

Advantages & disadvantages of these packaging materials; effect of these materials on packed commodities, Package testing, Printing, labeling and lamination.

Unit-4.

Economics of packaging; performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements; disposal and recycle of packaging waste.

Practical:

Identification of different types of packaging materials; determination of tensile strength of given material; Determination of compressive strength of given package; To perform different destructive tests for glass containers; To perform non-destructive tests for glass containers; Vacuum packaging of agricultural produces; Determination of tearing strength of paper board; measurement of thickness of packaging materials; To perform grease-resistance test in plastic pouches; Determination of bursting strength of packaging material; Determination of water-vapour transmission rate; Shrink wrapping of various horticultural produce; Testing of chemical resistance of packaging materials; Determination of drop test of food package; Visit to relevant industries.

Suggested Readings:

- Coles, R., McDowell, D., Kirwan, M. J. 2003. Food Packaging Technology. Blackwell Publishing Co.
- Gosby, N.T. 2001. Food Packaging Materials. Applied Science Publication
- John, P.J. 2008. A Handbook on Food Packaging Narendra Publishing House,
- Mahadevia, M., Gowramma, R.V. 2007. Food Packaging Materials. Tata McGraw Hill
- Robertson, G. L. 2001. Food Packaging and Shelf life: A Practical Guide. Narendra Publishing House.
- Robertson, G. L. 2005. Food Packaging: Principles and Practice. Second Edition. Taylor and Francis Pub.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Design and Maintenance of Greenhouse
Paper Code: AE404
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

History and types of greenhouse; importance, function and features of green house; scope and development of greenhouse technology.

Unit-2.

Location, Planning and various component of greenhouse; design criteria and calculation; constructional material and methods of construction; covering materials and its characteristics, solar heat transfer, solar fraction for green house, steady state analysis of green house.

Unit-3.

Greenhouse heating, cooling, shading and ventilation systems; Carbon Dioxide generation and monitoring and lighting systems, instrumentation & computerized environmental Control Systems. Watering, fertilization, root substrate and its pasteurization, containers and benches, plant nutrition.

Unit-4.

Alternative cropping systems; plant tissue culture, chemical growth regulation; disease control; integrated pest management; postproduction quality and handling Cost analysis of greenhouse production; Applications of green house & its repair & maintenance.

Practical:

Study/visit to a functional green house; planning and layout of green house & associated utilities; Material selection for the construction of green house; Measurement of temp. using thermomseter, thermistor & thermocouples inside the green house; Measurement of humidity & air velocity using various methods; Measurement of solar radiations inside the green house; Application of psychometric charts; estimation of cooling requirements in a green house; estimation of ventilation requirements; Thermal performance of green house; Application of data loggers for simultaneous estimation & control of different parameters like temp., RH, solar radiations etc.; Calculations of environment indices inside a greenhouse; Structural analysis of green house; Economic analysis of green house; Visit to a commercial green house.

Suggested Readings:

- Balraj Singh. 2006. Protected cultivation of vegetable crops. Kalyani Publishers, Ludhiana.
- Brahma Singh, 2014. Advances in Protected Cultivation. New India Publishing Agency. New Delhi.
- Reddy P. Parvatha, 2003. Protected Cultivation. Springer Publications. USA.
- Reddy, P. Parvatha. 2011. Sustainable crop protection under Protected Cultivation. Springer Publications. USA.
- Prasad S. 2005. Greenhouse Management for Horticultural Crops. Agrobios. Jodhpur.
- Jitendra Singh, S.K. Jain, L.K. Dashora, B.S. Cundawat.2013. Precision forming in Horticulture. New India Publishing Agency, New Delhi.
- T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Satheson. 2008. Management of Horticultural crops. New India Publishing Agency, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Waste and By-Product Utilization
Paper Code: AE405
w.e.f. Session 2019-20

Theory **2(1+1)**

Unit-1.

Types and formation of byproducts and waste; magnitude of waste generation in different food processing industries.

Unit-2.

Concept scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues.

Unit-3.

Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization,

Unit-4.

Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation.

Unit-5.

Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons.

Unit-6.

Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation.

Practical:

Waste characterization: (a) temperature (b) pH (c) solids content (d) turbidity (e) BOD (f) COD; Determination of ash content of agric. wastes; Determination of unburnt carbon in ash of paddy straw; To study about briquetting of agricultural residues; Estimation of excess air for better combustion of briquettes; To study about extraction of oil from rice bran; To study about waste treatment plant in food industry; To study about utilization of whey; To study about recovery of peel oil; To study about recovery of germ and germ oil from by-product of cereals; Practical on bioconversion of agro-wastes; Practical on recycling of agro-wastes and by-products; Visits to various industries using waste and food byproducts.

Suggested Readings:

- Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.
- Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Subtropical fruits and vegetables, AVI Pub. Co.

- Shewfelt, R.L. and Prussi, S.E. 1992. Post-Harvest Handling – A Systems approach, Academic Press Inc.
- USDA. 1992. Agricultural Waste Management Field Hand book. USDA, Washington DC.
- Weichmann J. 1987. Post Harvest Physiology of vegetables, Marcel and Dekker Verlag.
- V.K. Joshi & S.K. Sharma. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency.
- Vasso Oreopoulou and Winfried Russ (Edited). 2007. Utilization of By-products and Treatment of waste in the Food Industry. Springer Science & Business media, LLC 233 New York.
- Prashar, Anupama and Bansal, Pratibha. 2007-08. Industrial Safety and Environment. S.K. Kataria and sons, New Delhi
- Garg, S K. 1998. Environmental Engineering (Vol. II) – Sewage Disposal and Air Pollution Engineering. Khanna Publishers, New Delhi
- Bhatia, S.C.. 2001. Environmental Pollution and Control in Chemical Process Industries. Khanna Publishers, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Development of Processed Products & Equipments
Paper Code: AE406
w.e.f. Session 2019-20

Theory **3(2+1)**

Unit-1.

Applications of unit operations to the food industry, analytical processing concepts with regards to mass and energy balances, equipment involved in the commercially important food processing methods and unit operations; value addition to cereals like rice, wheat etc.

Unit-2.

Parboiling of rice, quality of processed products of rice & wheat. Processing of pulses, spices and condiments; extruded food product, fermented food product, frozen and dried product, technology of meat, fish and poultry products, technology of milk and milk products.

Unit-3.

Technology of oilseeds and fat products, snack foods, Fruits and vegetables product: candy, nutraceuticals, food product development trends, food additives and labeling. Process equipment for thermal processing-evaporation, dehydration, drying, blanching, pasteurization, distillation.

Unit-4.

Mechanical separation-filtration, sieving, centrifugation, sedimentation; mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.

Practical:

Working principle and operation of Engleberg huller; study of different cleaners and graders used in agro processing industries; working principle, operation and maintenance of paddy destoner-cum-cleaner, rubber roll sheller, paddy separator and vertical cone whitener; familiarization with operation and performance of machinery and equipments of Satake rice milling unit of 500 kg/hr; planning and layout of roller wheat flour milling & rice milling; visit to milk plant; visit to roller flour mill; visit to markfed canneries; visit to fruit/vegetable processing plants; flow process diagram and study of various models of the machines used in a sugar mill.

Suggested Readings:

- Geankoplis C. J. Transport processes and unit operations, Prentice-Hall.
- Rao, D. G. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
- Norman N. Potter and Joseph H. Hotchkiss. Food Science. Chapman and Hall Pub.
- Acharya, K T Everyday Indian Processed foods. National Book Trust.
- Mudambi Sumati R., Shalini M. Rao and M V Rajgopal. Food Science. New Age International Publishers.
- Negi H.P.S., Savita Sharma, K. S. Sekhon. Hand book of Cereal technology. Kalyani Pub.
- Mahajani, V. V. and Umarji, S. B., Process equipment design, Macmillan.
- Bhattacharyya, B. C., Introduction to Chemical Equipment design, CBS Publishers and Distributors.
- Geankoplis C. J. Transport processes and unit operations, Prentice-Hall.
- Rao, D. G. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Food Processing Plant Design & Layout
Paper Code: AE407
w.e.f. Session 2019-20

Theory

2 (1+1)

Unit-1.

Meaning and definition of plant layout. Objectives and principles of layout. Types of layout. Salient features of processing plants for cereals, pulses oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products.

Unit-2.

Location selection criteria, selection of processes, plant capacity, project design, flow diagrams, selection of equipments, process and controls, handling equipments.

Unit-3.

Plant layout, Plant elevation, requirement of plant building and its components, labour requirement, plant installation, power and power transmission, sanitation. Cost analysis, preparation of feasibility report.

Practical:

Planning, visit and layout of flour milling plant; Planning, visit and layout of rice milling plant; Planning, visit and layout of milk plant; Planning, visit and layout of bakery plant; Planning, visit and layout of fruits and vegetable dehydration plant; Planning, visit and layout of beverages industry; Planning, visit and layout of edible oil extraction plant; Planning, visit and layout of ice-cream plant; Planning, visit and layout of sugar mill plant; Planning, visit and layout of honey/turmeric/chillies processing plant.

Suggested Readings:

- Ahmed, T. 1997. Dairy Plant Engineering and Management. 4th Ed. Kitab Mahal. McCabe,
- W.L. and Smith, J. C. 1999. Unit Operations of Chemical Engineering. McGraw Hill.
- Rao, D.G. Fundamentals of Food Engineering. PHI learning Pvt. Ltd. New Delhi.
- Singh, R.P. & Heldman, D.R. 1993. Introduction to Food Engineering. Academic Press.
- Toledo, R. T. 1997. Fundamentals of Food Process Engineering. CBS Publisher.
- Farrel, A.W. 1963. Engineering for dairy and food products. Wiley

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Micro Irrigation Systems Design
Paper Code: AE408
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Past, present and future need of micro-irrigation systems, Role of Govt. for the promotion of micro-irrigation in India, Merits and demerits of micro-irrigation system, Types and components of micro-irrigation system.

Unit-2.

Micro-irrigation system- design, design synthesis, installation, and maintenance. Sprinkler irrigation - types, planning factors, uniformity and efficiency, laying pipeline, hydraulic lateral, sub-mains and main line design, pump and power unit selection.

Unit-3.

Drip irrigation – potential, automation, crops suitability. Fertigation – Fertilizer application criteria, suitability of fertilizer compounds, fertilizer mixing, injection duration, rate and frequency, capacity of fertilizer tank.

Unit-4.

Quality control in micro-irrigation components, design and maintenance of polyhouse; prospects, waste land development – hills, semi-arid, coastal areas, water scarce areas, Benefit and Cost analysis.

Practical:

Study of different types of micro-irrigation systems and components; Field visit of micro-irrigation system; Study of water filtration unit; Discharge measurement study of different micro-irrigation systems; Study of water distribution and uniformity coefficient; Study of wetted front and moisture distribution under various sources of micro-irrigation system; Design of micro-irrigation system for an orchard; Design of micro-irrigation system for row crops design of spray type micro-irrigation system; Design of micro-irrigation system for hilly terraced land; Study of automation in micro-irrigation system; Study of micro climate inside a Polyhouse; Study of maintenance and cleaning of different components of various systems; Design of sprinkler irrigation system; Design of landscape irrigation system.

Suggested Readings:

- Keller Jack and Bliesner Ron D. 2001. Sprinkle and Trickle Irrigation. Springer Science+ business Media, New York .
- Mane M.S. and Ayare B.L.2007. Principles of Sprinkler Irrigation systems, Jain Brothers, New Delhi.
- Mane M.S and Ayare B.L. and MagarS.S.2006.Principles of Drip Irrigation systems, Jain Brothers, New Delhi.
- Michael AM, Shrimohan and KR Swaminathan. Design and evaluation of irrigation methods, (IARI Monograph No.1). Water Technology Centre, IARI New Delhi.
- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Pub. House New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Watershed Planning and Management
Paper Code: AE409
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Watershed management - problems and prospects; watershed based land use planning, watershed characteristics – physical and geomorphologic, factors affecting watershed management.

Unit-2.

Hydrologic data for watershed planning, watershed delineation, delineation of priority watershed, water yield assessment and measurement from a watershed.

Unit-3.

Hydrologic and hydraulic design of earthen embankments and diversion structures; sediment yield estimation and measurement from a watershed and sediment yield models; rainwater conservation technologies - in-situ and storage, design of water harvesting tanks and ponds.

Unit-3.

Water budgeting in a watershed; effect of cropping system, land management and cultural practices on watershed hydrology; evaluation and monitoring of watershed programmes; people's participation in watershed management programmes; planning and formulation of project proposal; cost benefits analysis of watershed programmes; optimal land use models; case studies.

Practical:

Study of watershed characteristic; analysis of hydrologic data for watershed management; Delineation of watershed and measurement of area under different vegetative and topographic conditions; Measurement of water and sediment yield from watershed; Study of different watershed management structures; Study of various water budget parameters; Study of watershed management technologies; Preparation of a techno-economically effective project proposal.

Suggested Readings:

- Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.
- Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
- Sharda, V.N., A.K. Sikka and G.P. Juyal. 2006. Participatory Integrated Watershed Management: A Field Manual. Central Soil and Water Conservation Research and Training Institute, Dehradun.
- Singh, G.D. and T.C. Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.

- Singh, P.K. 2000. Watershed Management: Design and Practices. E-media Publications, Udaipur. y Singh, R.V. 2000. Watershed Planning and Management. Yash Publishing House, Bikaner.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Minor Irrigation and Command Area Development
Paper Code: AE410
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Major, medium and minor irrigation projects – their comparative performance; development and utilization of water resources through different minor irrigation schemes.

Unit-2.

Basic concepts of command area – definition, need, scope, and development approaches: historical perspective, command area development authorities; Interaction/collaboration of irrigation water use efficiency and agricultural production.

Unit-3.

Planning and execution of on farm development activities within the scope of command area development; Use of remote sensing techniques for command area development; case studies of some selected commands; Farmers participation in command area development.

Practical:

Topographic survey and preparation of contour map; preparation of command area development layout plan; land leveling design for a field; earthwork and cost estimation; irrigation water requirement of crops; preparation of irrigation schedules; planning and layout of water conveyance system; design of Irrigation systems; conjunctive water use planning; application of remote sensing for command area development; technical Feasibility and economic viability of a command area project. Study tour to minor irrigation and command area development projects.

Suggested Readings:

- Arora, K.R. 2001. Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
- Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ.House New Delhi.
- Sahasrabudhe SR. 2011. Irrigation Engineering and Hydraulic structures. SK Kataria & Sons Reprint 2015.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Environmental Engineering
Paper Code: AE411
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Importance of safe water supply system. Domestic water requirements for urban and rural areas. Sources of Water supply.

Unit-1.

Intakes and transportation of water. Drinking water quality. Indian Standards of drinking water. Introduction to water treatment. Importance of sanitation. Domestic waste water: quantity, characteristics, disposal in urban and rural areas.

Unit-3.

Sewer: types, design discharge and hydraulic design. Introduction to domestic wastewater treatment. Design of septic tank. Solid waste: quantity, characteristics and disposal for urban and rural areas.

Unit-1.

Introduction to air pollution. Types of pollutants properties and their effects on living beings. ISI standards for pollutants in air and their abetments.

Practical:

Determination of turbidity; pH of solution; Suspended solids; Dissolved solids; Total solids; Temporary hardness; Permanent hardness; Fluorides; Chlorides, dissolved oxygen; BOD; Collection of air samples and their analysis; Numerical problems related to theory; Visit to treatment plant.

Suggested Readings:

- Gilbert M. Masters and Wendell P. Ela. 2013. Introduction to Environmental Engineering and Science. Pearson Education Limited, NY, USA.
- Suresh K. Dhameja. 2009. Environmental Engineering and Management. S. K. Kataria & Sons, New Delhi.
- Bernard J. Nebel and Richard T. Wright.1993. Environmental Science: The Way the World Works. Prentice-Hall Professional, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Gully and Ravine Control Structures
Paper Code: AE412
w.e.f. Session 2019-20

Theory

3(2+1)

Unit-1.

Introduction; floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation.

Unit-2.

Estimation of flood peak - Rational method, empirical methods, Unit hydrograph method; Statistics in hydrology, flood frequency methods - Log normal, Gumbel's extreme value, Log-Pearson type-III distribution; depth-area-duration analysis; flood forecasting.

Unit-3.

Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method; flood control - history of flood control, structural and non-structural methods of flood control measures, storage and detention reservoirs, levees, channel improvement.

Unit-4.

Gully erosion and its control; soil erosion and sediment control measures; river training works, planning of flood control projects and their economics.

Practical:

Determination of flood stage-discharge relationship in a watershed; determination of flood peak-area relationships. Determination of frequency distribution functions for extreme flood values using Gumbel's method; Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution; Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution; Determination of probable maximum flood; Standard project flood and spillway design flood; Design of levees for flood control; Design of jetties; Study of vegetative and structural measures for Gully stabilization; Designing and planning of a flood control project; Cost and benefit analysis of a flood control project.

Suggested Readings:

- Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
- Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.
- Arora, K.R. 2014. Soil Mechanics and Foundation Engineering (Geotechnical Engineering). Standard Publishers Distributors, Delhi.
- Garg, S.K. 2014. Soil Mechanics and Foundation Engineering. Khanna Publishers Pvt. Ltd., New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Remote Sensing and GIS Application
Paper Code: AE413
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Remote Sensing: Definition, stage in remote sensing, modern remote sensing technology versus conventional aerial photography; visual image interpretation, image interpretation.

Unit-2.

Basic principles of image interpretation, factors governing the quality of an image; factors governing interpretability, visibility of objects, elements of image interpretation, techniques of image interpretation, digital image processing, digital image.

Unit-3.

Remote sensing in agriculture progress and prospects, microwave radiometry for monitoring agriculture crops and hydrologic forecasting; aerial photo interpretation for water resources development and soil conservation survey.

Unit-4.

GIS: History of development of GIS definition, basic components, and standard GIS packages; data-entry, storage and maintenance; data types-spatial-non-spatial (attribute data).

Unit-4.

Data structure, data format- point line vector-raster – polygon-object structural model, files, files organization-data base management systems (DBMS), entering data in computerdigitizer-scanner-data compression.

Practical:

Familiarization with remote sensing and GIS hardware; use of instruments for aerial photo interpretation; interpretation of aerial photographs and satellite imagery; basic GIS operations such as image display; study the various features of GIS software package; scanning and digitization of maps; data base query and map algebra; GIS supported case studies in water resources management.

Suggested Readings:

- Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
- George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
- Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
- Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.
- Sahu, K.C. 2008. Text Book of Remote Sensing and Geographic Information Systems. Atlantic Publishers and Distributors (P) Ltd., New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Reservoir and Farm Pond Design
Paper Code: AE414
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Earthen embankments - functions, advantages and disadvantages, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type.

Unit-2.

Foundation requirements, grouting, seepage through dams - estimation of seepage discharge, location of seepage/phreatic line by graphical and analytical methods, flow-net and its properties.

Unit-3.

Seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes; design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc.

Unit-1.

Stability of slopes - analysis of failure by slice method; types of reservoirs and farm ponds, design and estimation of earth work; cost analysis.

Practical:

Study of different types and materials of earthen dams; Determination of the position of phreatic line in earth dams for various conditions; Stability analysis of earthen dams against head water pressure; Stability analysis of earthen dams against foundation shear; Stability analysis of earth dams against sudden draw down condition; Stability of slopes of earth dams by friction circle method / different methods; construction of flow net for isotropic and anisotropic medium; Computation of seepage by different methods; determination of settlement of earth dam; Input-output-storage relationships by reservoir routing; design of farm ponds; cost estimation of farm ponds and other structures.

Suggested Readings:

- Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
- Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
- Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1993. Soil and Water Conservation Engineering. 4th Edition, John Wiley and Sons Inc. New York.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
- Samra, J.S., V.N. Sharda and A.K. Sikka. 2002. Water Harvesting and Recycling: Indian Experiences. CSWCR&TI, Dehradun, Allied Printers, Dehradun.
- Theib Y. Oweis, Dieter Prinz and Ahmed Y. Hachum. 2012. Rainwater Harvesting for Agriculture in the Dry Areas. CRC Press, Taylor and Francis Group, London.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Tractor Design and Testing
Paper Code: AE415
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution.

Unit-2.

Hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors.

Unit-3.

Design of Ackerman Steering and tractor hydraulic systems. Study of special design features of tractor engines and their selection.

Unit-4.

Design of seat and controls of an agricultural tractor. Tractor Testing.

Practical:

Design problem of tractor clutch – (Single/ Multiple disc clutch); Design problem on spur gears; Design problem of bevel gears; Design problem of helical gears; Design of gear box(synchromesh/constant mesh); Design of variable speed constant mesh drive; Selection of tractor tires – Problem solving; Problem on design of governor; Problem related to selection of hydraulic pump; Engine testing as per BIS code – various test; Drawbar performance in the lab; PTO test and measure the tractor power in the lab/field; Determining the turning space, turning radius and brake test, hydraulic pump performance test and air cleaner and noise measurement test; Visit to tractor testing centre/industry.

Suggested Readings:

- Liljedahl J B & Others. 2012. Tractors and Their Power Units. 4th Edition. Springer Publication.
- Raymond N, EA Yong and S Nicolas. Vehicle Traction Mechanics Vol-3. 1st Edition. Elsevier Science Publication.
- Maleev VL. 1964. Internal Combustion Engines. 2nd Edition. McGraw Hill Inc. Publication.
- Kirpal Singh. 2014. Automobile Engineering – Vol I and Vol II. 13th Edition. Standard Publications-Delhi
- Richey C.B. 1961. Agricultural Engineering Handbook. McGraw-Hill Inc. Publication.
- Mehta ML, SR Verma, SK Mishra, VK Sharma. 2016. Testing & Evaluation of Agricultural Machinery. Daya Publishing House, Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Hydraulic Drives and Controls
Paper Code: AE416
w.e.f. Session 2019-20

Theory

3(2+1)

Unit-1.

Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements.

Unit-2.

Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors. Pumps, Pump Classifications, Performance, Displacement, Designs, Gear Pumps, Vane Pumps, Piston Pumps, Pump Operation.

Unit-3.

Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors. Valves, Pressure-Control Valves, Directional Control Valves, Flow-Control Valves, Valve Installation, Valve Failures and Remedies.

Unit-4.

Valve Assembly, Troubleshooting Valves Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC.

Unit-5.

Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Use of Hydraulics and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls).

Practical:

Introduction to Hydraulic Systems; Study of Hydraulic Pumps; Study of Hydraulic Actuators; Study of Hydraulic Motors; Study of Hydraulic Valves; Hydraulic codes and circuits; Building simple Hydraulic Circuits; Hydraulics in Tractors; Introduction to Pneumatics; Pneumatics Devices; Pneumatics in Agriculture; Use of Hydraulics and Pneumatics for Robotics.

Suggested Readings:

- R.A. Kepner, Roy Bainer & E.L. Barger. Principles of Farm Machinery, 3rd Edition, CBS Publishers & Distributors.
- Anthony E. 2008. Fluid Power and Applications. 7th Edition, Pearson publication.
- Majumdar S.R. 2017. Oil Hydraulic System-Principle and Maintenance. 28th Edition. McGraw Hill Education.
- Merit Herbert E. 1967. Hydraulic Control Systems. 1st Edition. John Wiley and Sons Publication.
- John Deere. 1999. Fundamentals of Service Hydraulics. 6th Edition. Deere & Co. Publication.

B.Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Farm Power & Machinery Management
Paper Code: AE417
w.e.f. Session 2019-20

Theory

3(2+1)

Unit-1

The role of mechanization and its relationship to productivity, employment, social and technological change.

Unit-2.

Performance and power analysis; cost analysis of machinery: fixed cost and variable costs, effect of inflation on cost.

Unit-3.

Selection of optimum machinery and replacement criteria; Break-even analysis, reliability and cash flow problems.

Unit-4.

Mechanization planning; case studies of agricultural mechanization in India.

Practical:

Solving problems related to Various capacities, pattern efficiency, system limitation, power requirement and other operational parameters; Solving of Problems related to cost analysis and inflation; Solving problem related to selection of equipment, replacement, break-even analysis, time value of money etc.; Presentation of seminar on topic assigned related to farm machinery management; Design of farm mechanization plan for different farm size and cropping pattern.

Suggested Readings:

- Hunt Donnell and Wilson David. 2016. Farm Power and Machinery Management.11Th Edition, Waveland Press Inc, Long Grove, Illinois.
- Sharma DN and S Mukesh. 2013. Farm Power and Machinery Management Vol. I. Jain Brothers, New Delhi.
- Richey, C.B. 1961. Agricultural Engineers` Handbook. McGraw Hill Book Company, New York.

B.Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Renewable Energy Technologies
Paper Code: AE418
w.e.f. Session 2019-20

Theory

3 (2+1)

Design and operational parameters, performance evaluation and maintenance aspects of different renewable technologies like:

Unit-1.

Gasifiers, biogas plants.

Unit-2.

Solar passive heating devices, photovoltaic cells and arrays.

Unit-3.

Briquetting machines and balers.

Unit-4.

Bio-diesel utilization in CI engines.

Practical:

Performance evaluation of solar water heater; performance evaluation of solar cooker; Characteristics of solar photovoltaic panel; evaluation of solar air heater/dryer; Performance evaluation of a rice husk throatless gasifier engine system; Performance evaluation of down draft gasifier with throat for thermal application; Performance evaluation of a fixed dome type biogas plant; Performance evaluation of floating drum type biogas plant; Estimation of calorific value of producer gas; Testing of diesel engine operation using biodiesel; Evaluation of briquetting machine using biomass material; evaluation of rice straw briquette.

Suggested Readings:

- Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
- Rai, G.D., Solar Energy Utilization, Khanna Publishers, Delhi.
- Khandelwal, K.C. & S. S. Mahdi. 1990. Biogas Technology- A Practical Handbook.
- Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Non Conventional Energy Sources, Himanshu Publications.
- Tiwari, G.N. and Ghoshal, M.K. 2005. Renewable Energy Resources: Basic Principles and Applications. Narosa Pub. House. Delhi.
- Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Renewable Energy, Theory and Practice, Himanshu Publications.
- Reed TB and Das A. Handbook of Biomass Downdraft Gasifier Engine System. The Biomass Energy Foundation Press, Colorado; 1984.

B.Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Human Engineering and Safety
Paper Code: AE419
w.e.f. Session 2019-20

Theory

3(2+1)

Unit-1.

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance.

Unit-2.

Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications.

Unit-3.

Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices.

Unit-4.

Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution. Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims.

Unit-5.

Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

Practical:

Calibration of the subject in the laboratory using bi-cycle Ergometer as loading device, versus different physiological parameters; Calibration of the subject in the laboratory using mechanical treadmill as loading device versus different physiological parameters; Study of Respiration gas meter and its use in selected farm operation and their comparison from energy point of view; Calibration of the subject using Heart Rate Monitor and farm operation as a loading device; Study of general fatigue of the subject using Blink ratio method; Study on the use of electromyograph equipment; Anthropometric measurements of a selected group of farm workers and its statistical analysis; Study of optimum work space layout and locations of controls of different factors; Familiarization of the noise and vibration equipment.

Suggested Readings:

- Chapanis A. 1996. Human Factors in System Engineering. John Wiley & Sons, New York.
- Dul J. and Weerdmeester B. 1993. Ergonomics for Beginners. A Quick Reference Guide. Taylor and Francis, London.
- Mathews J. and Knight A. A. 1971. Ergonomics in Agricultural Equipment Design. National Institute of Agricultural Engineering.
- Mark S. Sanders and Ernest James McCormick. 1993. Human Factors in Engineering and Design. Mc Hill Corporation, New York.
- Keegan J J, Radke AO. 1964. Designing vehicle seats for greater comfort. SAE Journal;72:50~5.
- Yadav R, Tewari V.K. 1998. Tractor operator workplace design-a review. Journal of Terra mechanics 35: 41-53.

B.Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Biomass Management for Fodder and Energy
Paper Code: AE420
w.e.f. Session 2019-20

Theory

3(1+1)

Unit-1.

Introduction to biomass management, biomass resource assessment management techniques/supply chains.

Unit-2.

Processing of paddy straw, densification- Extrusion process, pellets, mills and cubers, Bailing-classification, uses; residue management for surface mulch and soil incorporation.

Unit-3.

Paddy Straw choppers and spreaders as an attachment to combine Harvester, Mulch seeder, Paddy Straw Chopper-cum-Loader, Balar for collection of straw.

Unit-4.

Processing of straw/fodder for animal use; Agricultural and horticultural use, Cushioning material for fruits and vegetables, Mulching and Composting, Paper and cardboard manufacturing, Straw as a fuel.

Practical:

Familiarization with different straw management techniques; on-farm and off-farm uses of straw; collection, loading and transport equipments for unbruised loose straw; briquetting machine and preparation of briquettes; straw baler and making of bales in the field; straw/ fodder chopping machines; straw/mulching & incorporating machinery; machinery requirement for baling forage crops for silage.

Suggested Readings:

- R.A. Kepner, Roy Bainer & E.L. Barger. Principles of Farm Machinery, 3rd Edition, CBS Publishers & Distributors.
- Shields Avenue, Davis, Biomass Resource Assessment California Biomass Collaborative Biological & Agricultural Engineering University of California, CA 95616- 5924.
- Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
- Khandelwal, K.C. & S. S. Mahdi. 1990. Biogas Technology- A Practical Handbook.
- Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Non Conventional Energy Sources, Himanshu Publications.
- Tiwari, G.N. and Ghoshal, M.K. 2005. Renewable Energy Resources: Basic Principles and Applications. Narosa Pub. House. Delhi.

B.Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Production Technology of Agricultural Machinery
Paper Code: AE421
w.e.f. Session 2019-20

Theory

3 (2+1)

Unit-1.

Critical appraisal in production of Agricultural Machinery; Modelling and stress analysis of Machinery parts by using standard software.

Unit-2.

Advances in material used for tractor & Agril. Machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques like powder metallurgy, EDM (Electro-Discharge Machining).

Unit-3.

Heat Treatment of steels including pack carburizing, shot pining process, chemical vapor deposition (CVD) etc. Limits, Fits & Tolerances, Jigs & Fixtures, Microstructure Analysis. Industrial lay-out planning.

Unit-4.

Quality management,. Economics of process selection. Techno-economic feasibility of Project Report. Selection of Standard/ critical components. Case studies of manufacturing of agril. machinery.

Unit-5.

Servo motors, drives & controllers, CNC controllers for machine tools. CNC programming. Assembly and plant automation. Storage and transportation.

Practical:

To draw an exhaustive design plan for a machine & describe its kinematics; Part modelling of agril. machinery by using standard software; Problem on design of cultivator and drill parts; Problem on design of sprayer parts and fluid flow; Problem on design of harvesting and threshing machinery parts; Visit to Central Tool Room/ Industry with Advanced manufacturing techniques; Jigs and Fixtures – study in relation to Agril Machinery; Design problems on fits, tolerances and limits; Layout planning of a small scale industry; Problem on Economics of process selection; Preparation of a project report; Case study for manufacturing of weeder/thresher through industry visit; Study of different CNC controllers/ servo motors; CNC programming; Case studies for manufacturing of tractor through industry visit.

Suggested Readings:

- Callister, W.D. Materials science and engineering. Wiley, New Delhi.
- Everett.E.Adam and JR.Ronald. J.Ebert. Production and operations management concepts, models and behaviour. Prentice Hall of India Pvt Ltd, New Delhi.
- Martand.T.Telsang. Production management. S Chand and company Ltd, Ram nagar., New Delhi.
- Paul Degram.E, Blach.J.T and Ronald A Kosher. Materials and process in manufacturing., . Prentice Hall of India.
- Prabhu Dev. Handbook of heat treatment of steel. Tata McGraw Hill.Ltd, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Mechanics of Tillage and Traction
Paper Code: AE422
w.e.f. Session 2019-20

Theory

3(2+1)

Unit-1.

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship.

Unit-2.

Design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics performance of tillage tools.

Unit-3.

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction, tyre size, tyre lug geometry and their effects, tyre testing.

Unit-4

Soil compaction and plant growth, variability and geo statistic, application of GIS in soil dynamics.

Practical:

Measurement of static and dynamic soil parameters related to tillage; Measurement of soil parameters related to puddling and floatation; Measurement of draft for passive rotary and oscillating tools; Measurement of slip and sinkage under dry and wet soil conditions; Measurement of load and fuel consumption for different farm operations; Economics of weight transfer and tractor loading including placement and traction aids; Studies on tyres, tracks and treads under different conditions; Studies on compaction and number of operations.

Suggested Readings:

- William R. Gill, Glen E. Vanden Berg. Soil Dynamics in Tillage and Traction, Scientific Publishers (India)
- Liljedahl JB and others. Traction and Their Power Units, 4th Edition, Publisher: CBS Publishers and Distributors Pvt Ltd.
- Daniel Hill. Fundamentals of Soil Physics. 1st Edition, Academic Press.
- Terzaghi K & Peck Ralph B. Soil Mechanics in Engineering Practices, 3rd Edition, A Wiley-Interscience Publication John Wiley & Sons, Inc. New York.

B. Tech. Agricultural Engineering
SEMESTER-VII
Syllabus: Systems Engineering
Paper Code: AE423
w.e.f. Session 2019-20

Theory

3 (3+0)

Unit-1.

System concepts. Requirements for a Linear programming problems. Mathematical formulation of Linear Programming problems and its Graphical solution.

Unit-2.

Response of systems. Computer as a tool in system analysis. Simplex method. Degeneracy and Duality in linear programming.

Unit-3.

Artificial variable techniques, Big M method and two-phase methods. Mathematical models of physical systems.

Unit-4.

Modelling of Agricultural Systems and operations. Cost analysis. Transportation problems. Assignment problems. Waiting line problems.

Unit-5.

Project management by PERT/CPM. Resource scheduling.

Suggested Readings:

- Charles S. Wasson. System Engineering Analysis, Design, and Development: Concepts, Principles, and Practices (Wiley Series in Systems Engineering and Management) 2nd Edition, Wiley Publisher.
- D Kothari. 2008. Power System Engineering, 2nd Edition. Mc Graw Hill Book Company.