Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Undergraduate program
B. Tech. Agricultural Engineering
w.e.f. Session 2021-22
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						
AE441	10- weeks Industrial Attachment /Internship (Student READY**)**	-	-	-	-	-	-	5	5	10	90	100	-	**100***	0:0:10	10
AE442	10- weeks Experiential Learning On campus (Student READY)	-	-	-	-	-	-	5	5	10	90	100	-	**100***	0:0:10	10
AE443	Skill Development Training-II (Student READY) Registration only	-	-	-	-	-	-	5	5	10	90	100	-	**100***	0:0:05	05
AE444	Educational Tour (Registration only)	-	-	-	-	-	-	5	5	10	90	100	-	**100***	0:0:02	02
	Total													**100**		**27**

Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Undergraduate program
B. Tech. Agricultural Engineering
w.e.f. Session 2021-22
Semester – VIII

Course Code	Subject	Periods Per h/week/ sem			Evaluation Scheme Theory Mid sem			Evaluation Scheme Practical Examination					End sem Theory Exam	Subject total	Credit	Total Credit Points
								Sessional			End sem exam	Sub Total (sessional + exam)				
		L	T	P	CT	TA	Total	CT	TA	Total	Total					
AE464	Food Quality and Control	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE470	Waste and By-products Utilization	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE458	Mechanics of Tillage and Traction	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE447	Project Planning and Report Writing (Student READY)	0	0	0	0	0	**0**	5	5	**10**	**90**	**100**	0	**100**	0:0:10	10(0+10)
Total																19(6+13)
* Students are required to select any three courses of 3 credits each from the list during 8th Semester																
Elective Course																
AE448	Floods and Control Measures	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE449	Wasteland Development	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE450	Information Technology for Land and Water Management	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE451	Remote Sensing and GIS Applications	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE452	Management of Canal Irrigation System	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE453	Minor Irrigation and Command Area Development	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE454	Precision Farming Techniques for Protected Cultivation	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE455	Water Quality and Management	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)

	Measures															
AE456	Landscape Irrigation Design and Management	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE457	Plastic Applications in Agriculture	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE458	Mechanics of Tillage and Traction	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE459	Farm Machinery Design and Production	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE460	Human Engineering and Safety	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE461	Tractor Design and Testing	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE462	Hydraulic Drives and Controls	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE463	Precision Agriculture and System Management	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE464	Food Quality and Control	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE465	Food Plant Design and Management	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE466	Food Packaging Technology	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE467	Development of Processed Products	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE468	Process Equipment Design	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE469	Photovoltaic Technology and Systems	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE470	Waste and By-products Utilization	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE471	Artificial Intelligence	3	0	0	10	10	**20**	-	-	-	-	**20**	80	**100**	2:0:1	3(2+1)
AE472	Mechatronics	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
Total																140(85+55)
* Students are required to elect any three courses of 3 credits each from the list during 8th Semester																

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Floods and Control Measures
Paper Code:AE448
w.e.f. Session 2021-22

3(2+1)

Theory

Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation; 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. Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method. Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement. Gully erosion and its control structures - design and implementation. Ravine control measures. River training works, planning of flood control projects and their economics. Earthen embankments - functions, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type, foundation requirements, grouting, seepage through dams, flow net and its properties, 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., stability of slopes - analysis of failure by different methods. Subsurface dams - site selection and constructional features. Check dam - Small earthen embankments - types and design criteria. Subsurface dams - site selection and constructional features.

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 confidence limits of the flood peak estimates for Gumbel's extreme value distribution. Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III 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. Design of gully/ravine control structures and cost estimation. Designing, planning and cost-benefit analysis of a flood control project. Study of different types, materials and design considerations 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, foundation shear, sudden draw down condition etc. Stability of slopes of earth dams by friction circle and other methods. Construction of flow net for isotropic and anisotropic media. Computation of seepage by different methods. Determination of settlement of earth dam. Input-output-storage relationships by reservoir routing. Visit to sites of earthen dam and water harvesting structures.

Suggested Readings:

- 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.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
- Mutreja, K.N. 1990. Applied Hydrology. Tata McGraw-Hill Publishing Co., New York, Delhi.
- Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.

- Bureau of Reclamation. 1987. Design of Small Dams. US Department of Interior, Washington DC, USA.
- 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.
- Stephens Tim. 2010. Manual on Small Earth Dams - A Guide to Siting, Design and Construction. Food and Agriculture Organization of the United Nations, Rome.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Wasteland Development
Paper Code:AE449
w.e.f. Session 2021-22

3(2+1)

Theory

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands. Wastelands - factors causing, classification and mapping of wastelands, planning of wastelands development - constraints, agro climatic conditions, development options, contingency plans. Conservation structures - gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods. Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints. Shifting cultivation, optimal land use options. Wasteland development – hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands. Mine spoils-impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management. Micro-irrigation in wastelands development. Sustainable wasteland development - drought situations, socio-economic perspectives. Government policies. Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

Practical

Mapping and classification of wastelands. Identification of factors causing wastelands. Estimation of vegetation density and classification. Planning and design of engineering measures for reclamation of wastelands. Design and estimation of different soil and water conservation structures under arid, semiarid and humid conditions. Planning and design of micro-irrigation in wasteland development. Cost estimation of the above measures / structures. Visit to wasteland development project sites.

Suggested Readings:

- Abrol, I.P., and V.V. Dhruvanarayana. 1998. Technologies for Wasteland Development. ICAR, New Delhi.
- Ambast, S.K., S.K. Gupta and Gurcharan Singh (Eds.) 2007. Agricultural Land Drainage - Reclamation of Waterlogged Saline Lands. Central Soil Salinity Research Institute, Karnal, Haryana.
- Hridai Ram Yadav. 2013. Management of Wastelands. Concept Publishing Company. New Delhi.
- Karthikeyan, C., K. Thangaraja, C. Cinthia Fernandez and K. Chandrakandon. 2009. Dryland Agriculture and Wasteland Management. Atlantic Publishers and Distributors Pvt. Ltd., New Delhi.
- Rattan Lal and B.A. Stewart (Ed.). 2015. Soil Management of Smallholder Agriculture. Volume 21 of Advances in Soil Science. CRC Press, Taylor and Francis Group, Florida, USA.
- Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Springer Heidelberg, New York.
- Swaminathan, M.S. 2010. Science and Integrated Rural Development. Concept Publishing Company (P) Ltd., Delhi.
- The Energy and Resources Institute. 2003. Looking Back to Think Ahead-Green India 2047. Growth with Resource Enhancement of Environment and Nature. New Delhi.
- Virmani, S.M. (Ed.). 2010. Degraded and Wastelands of India: Status and Spatial Distribution. ICAR, New Delhi.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Information Technology for Land and Water Management
Paper Code:AE450
w.e.f. Session 2021-22

3(2+1)

Theory

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Existing system of information generation and organizations involved in the field of land and water management. Application and production of multimedia. Internet application tools and web technology. Networking system of information. Problems and prospects of new information and communication technology. Development of database concept for effective natural resources management. Application of remote sensing, geographic information system (GIS) and GPS. Rational data base management system. Object oriented approaches. Information system, decision support systems and expert systems. Agricultural information management systems - use of mathematical models and programmes. Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.

Practical

Multimedia production. Internet applications: E-mail, voice mail, web tools and technologies. Handling and maintenance of new information technologies and exploiting their potentials. Exercises on database management using database and spreadsheet programmes. Usage of remote sensing, GIS and GPS survey in information generation and processing. Exercises on running computer software packages dealing with water balance, crop production, land development, land and water allocation, watershed analysis etc. Exercises on simple decision support and expert systems for management of natural resources. Multimedia production using different softwares. Exercises on development of information system on selected theme(s). Video-conferencing of scientific information.

Suggested Readings:

- Climate-Smart Agriculture – Source Book. 2013. Food and Agriculture Organization, Rome.
- Daniel P. Loucks and Eelco van Beek. 2005. Water Resources Systems Planning and Management - An Introduction to Methods, Models and Applications. UNESCO, Paris.
- Dipak De and Basavaprabhu Jirli (Eds.). 2010. Communication Support for Sustainable Development. Ganga Kaveri Publishing House, Varanasi – 221001. y FAO. 1998. Land and Water Resources Information Systems. FAO Land and Water Bulletin 7, Rome.
- Fuling Bian and Yichun Xie (Eds.). 2015. Geo-Informatics in Resource Management and Sustainable Ecosystem. Springer, New York.
- ICFAI Business School (IBS). 2012. Information Technology and Systems. IBS Centre for Management Research, Hyderabad.
- Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Environmental Science. Springer, New York.
- Sarvanan. R. 2011. Information and Communication Technology for Agriculture and Rural Development. New India Publishing Agency, New Delhi.
- Soam, S.K., P.D. Sreekanth and N.H. Rao (Eds.). 2013. Geospatial Technologies for Natural Resources Management. New India Publishing Agency, Delhi.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Remote Sensing and GIS Applications
Paper Code:AE451
w.e.f. Session 2021-22

3(2+1)

Theory

Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water; spectral signatures; different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation- interpretation elements; photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices; microwave remote sensing. GI Sand basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.

Practical

Familiarization with remote sensing and GIS hardware; use of software for image interpretation; interpretation of aerial photographs and satellite imagery; basic GIS operations such as image display; study of various features of GIS software package; scanning, digitization of maps and data editing; 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.
- Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
- George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
- Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
- 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.
- Shultz, G.A. and E.T. Engman. 2000. Remote Sensing in Hydrology and Water Management. Springer, New York

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Management of Canal Irrigation System
Paper Code:AE452
w.e.f. Session 2021-22

3(2+1)

Theory

Purpose benefits and ill effects of irrigation; typical network of canal irrigation system and its different physical components; canal classification based on source of water, financial output, purpose, discharge and alignment; canal alignment: general considerations for alignment; performance indicators for canal irrigation system evaluation, Estimation of water requirements for canal command areas and determination of canal capacity; water duty and delta, relationship between duty, base period and delta, factors affecting duty and method of improving duty; silt theory: Kennedy's theory, design of channels by Kennedy's theory, Lacey's regime theory and basic regime equations, design of channels by Lacey's theory, maintenance of unlined irrigation canals, measurement of discharge in canals, rostering (canal running schedule) and warabandhi, necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials; design of lined canals; functions of distributary head and cross regulators; canal falls, their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet.

Practical

Estimation of water requirement of canal commands; determination of canal capacity; layout of canal alignments on topographic maps, drawing of canal sections in cutting, full banking and partial cutting and partial banking; determination of longitudinal section of canals; design of irrigation canals based on silt theories; design of lined canals; formulation of warabandhi; Study of canal outlets, regulators, escapes and canal falls.

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.
- Sahasrabudhe SR. 2011. Irrigation Engineering and Hydraulic structures. SK Kataria & Sons Reprint 2015.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Minor Irrigation and Command Area Development
Paper Code: AE453
w.e.f. Session 2021-22

3(2+1)

Theory

Factors affecting performance of irrigation projects; types of minor irrigation systems in India; lift irrigation systems: feasibility, type of pumping stations and their site selection, design of lift irrigation systems; tank Irrigation: grouping of tanks, storage capacity, supply works and sluices; command area development (CAD) programme- components, need, scope, and development approaches, historical perspective, command area development authorities functions and responsibilities; on farm development works, reclamation works, use of remote sensing techniques for CAD works; water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development;

Practical

Preparation of command area development layout plan; Irrigation water requirement of crops; Preparation of irrigation schedules; Planning and layout of water conveyance system; design of surplus weir of tanks; determination of storage capacity of tanks; design of intake pipe and pump house.

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-VIII
Syllabus: Precision Farming Techniques for Protected Cultivation
Paper Code: AE454
w.e.f. Session 2021-22

3(2+1)

Theory

Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shed nets, Cladding materials, Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment, Design and construction of green houses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment, Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fan pad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc. Greenhouse heating – necessity, components, methods, design of heating system. Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in green house cultivation. Irrigation in greenhouse and net house – Water quality, types of irrigation system, components, design, installation and material requirement. Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Maintenance of irrigation and fogging systems. Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of proper application of fertilizers, fertilizer scheduling, rate of application of fertilizers, methods, automated fertilizer application. Greenhouse climate measurement, control and management. Insect and disease management in greenhouse and net houses Selection of crops for greenhouse cultivation, major crops in greenhouse – irrigation requirement, fertilizer management, cultivation, harvesting and post harvest techniques; Economic analysis.

Practical

Estimation of material requirement for construction of greenhouse ; Determination of fertilization schedule and rate of application for various crops; Estimation of material requirement for preparation of root media; Root media preparation, bed preparation and disinfections; Study of different planting techniques ; Design and installation of irrigation system; Design and installation of fogging system ; Greenhouse heating; Study of different greenhouse environment control instruments; Study of operation maintenance and fault detection in irrigation system; Study of operation maintenance and fault detection in fogging system; Economic analysis of greenhouses and net houses; Visit to greenhouses.

Suggested Readings:

- Singh Brahma and Balraj Singh. 2014. Advances in protected cultivation, New India Publishing Company.
- Sharma P. 2007. Precision Farming. Daya Publishing House New Delhi.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Water Quality and Management Measures
Paper Code: AE455
w.e.f. Session 2021-22

3(2+1)

Theory

Natural factors affecting quality of surface water and groundwater, water quality objectives in relation to domestic, industrial and agricultural activities, drinking water quality standards, irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria, point and non-point water pollution sources, water contamination due to inorganic and organic compounds, water contamination related to agricultural chemicals, food industry, hydrocarbon and synthetic organic compounds. Arsenic and fluoride contamination in groundwater and remedial measures, water decontamination technologies, cultural and management practices for using poor quality water for irrigation.

Practical

Water quality analysis and classification according to USSL and AICRP criteria; soil chemical analysis and estimation of lime and gypsum requirements; study of salinity development under shallow and deep water table conditions; study of contamination movement and transport in soil profile; study of different water decontamination techniques; study of different cultural and management practices for using poor quality water for irrigation; field visit to industrial effluent disposal sites.

Suggested Readings:

- FAO. 1996. Control of water pollution from agriculture - FAO irrigation and drainage paper 55.
- Gray, N.F. Water Technology. Raj Kamal Electric Press, Kundli, Haryana.
- Hussain, S.K. 1986. Text Book of Water Supply and Sanitary Engineering. Oxford & IBH Publishing Co. New Delhi.
- Manahan, S.E. 2009. Fundamentals of Environmental Chemistry. CRC Press, New York.
- McGauhey, P.H. 1968. Engineering Management of water quality. McGraw Hill Book Company, New York.
- Minhas, P.S. and Tyagi, N.K. 1998. Guidelines for irrigation with saline and alkali waters. Bull. No, 1/98, CSSRI, Karnal, p. :36.
- Punmia, B.C. and Lal, P.B.B. 1981. Irrigation and water power engineering. Standard Publishers Distributors, Delhi.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Landscape Irrigation Design and Management
Paper Code: AE456
w.e.f. Session 2021-22

3(2+1)

Theory

Conventional method of landscape irrigation- hose irrigation system, quick release coupling system and portable sprinkler with hose pipes; Modern methods of landscape irrigation- pop-up sprinklers, spray pop-up sprinkler, shrub adopter, drip irrigation and bubblers; Merits and demerits of conventional and modern irrigation systems, types of landscapes and suitability of different irrigation methods, water requirement for different landscapes, Segments of landscape irrigation systems, Main components of modern landscape irrigation systems and their selection criteria; Types of pipes, pressure ratings, sizing and selection criteria; Automation system for landscape irrigation- main components, types of controllers and their application, Design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems.

Practical

Study of irrigation equipments for landscapes; Design and installation of irrigation system for landscape, determination of water requirement. Determination of power requirement, pump selection. Irrigation scheduling of landscapes, Study of irrigation controllers and other equipments, Use of AutoCAD in irrigation design: blocks & symbols, head layout, zoning and valves layout, pipe sizing, Pressure calculations etc., Visit to landscape irrigation system and its evaluation.

Suggested Readings:

- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ. House New Delhi. y Singh Neeraj Partap. 2010. Landscape Irrigation and Floriculture Terminology, Bangalore.
- Smith Stepehen W. Landscape Irrigation and Management. Amazon. com.

B. Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Plastic Applications in Agriculture
Paper Code: AE457
w.e.f. Session 2021-22

3(2+1)

Theory

Introduction of plasticulture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management. Quality control measures. Present status and future prospective of plasticulture in India. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Drip and sprinkler irrigation systems. Use of polymers in control of percolation losses in fields. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation. Nursery management - Use of plastics in nursery raising, nursery bags, trays etc. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers. Plastic nets for crop protection - anti insect nets, bird protection nets. Plastic fencing. Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products. Plastic cap covers for storage of food grains in open. Use of plastics as alternate material for manufacturing farm equipment and machinery. Plastics for aquacultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Silage film technique for fodder preservation. Agencies involved in the promotion of plasticulture in agriculture at national and state level. Human resource development in plasticutlure applications.

Practical

Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting ponds. Study of plastic components of drip and sprinkler irrigation systems, laying and flushing of laterals. Study of components of subsurface drainage system. Study of different colour plastic mulch laying. Design, estimation and installation of green, poly and shade net houses, low tunnels etc. Study on cap covers for food grain storage, innovative packaging solutions - leno bags, crates, bins, boxes, vacuum packing, unit packaging, CAS and MAP and estimation. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation. Study of plastic parts in making farm machinery. Visits to nearby manufacturing units/dealers of PVC pipes, drip and sprinkler irrigation systems, greenhouse/ polyhouse/shadehouse/ nethouse etc. Visits to farmers' fields with these installations.

Suggested Readings:

- Brahma Singh, Balraj Singh, Naved Sabir and Murtaza Hasan. 2014.Advances in Protected Cultivation. New India Publishing Agency, New Delhi.
- Brown, R.P. 2004. Polymers in Agriculture and Horticulture. RAPRA Review Reports : Vol. 15, No. 2, RAPRA Technology Limited, U.K.
- Central Pollution Control Board. 2012. Material on Plastic Waste Management. Parivesh Bhawan, East Arjun Nagar, Delhi-110032.
- Charles A. Harper. 2006. Handbook of Plastics Technologies. The Complete Guide to Properties and Performance. McGraw-Hill, New Delhi.
- Dubois. 1978. Plastics in Agriculture. Applied Science Publishers Limited, Essex, England.
- Manas Chanda, Salil K. Roy. 2008. Plastics Fundamentals, Properties, and Testing. CRC Press.
- Ojha,T.P. and Michael, A.M., 2012, Principles of Agricultural Engineering - I. Jain Brothers, Karol Bagh, New Delhi.
- Pandey, P.H. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana, India.
- Shankar, A.N. 2014. Integrated Horticulture Development in Eastern Himalayas, Plasticulture in Agri-Horticulture Systems, 241-247.

- Srivastava, R.K., R.C. Maheswari, T.P. Ojha, and A. Alam. 1988. Plastics in Agriculture. Jain Brothers, Karol Bagh, New Delhi.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Mechanics of Tillage and Traction
Paper Code: AE458
w.e.f. Session 2021-22

3(2+1)

Theory
Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship, design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics and traction prediction equation. Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, tyre size, tyre lug geometry and their effects, tyre testing, soil compaction and plant growth, variability and application of GIS in soil dynamics.
Practical
Measurement of static and dynamic soil parameters related to tillage, soil parameters related to puddling and floatation, draft for passive rotary and oscillating tools, slip and sinkage under dry and wet soil conditions and load and fuel consumption for different farm operations; Weight transfer and tractor loading including placement and traction aids; Studies on tyres, tracks and treads under different conditions, and soil compaction and number of operations.
Suggested Readings:

- Vandenberg and Gill. Tillage and Traction.
- Liljedahl JB and others. Tractor and Power Units.
- Daniel Hill. Fundamentals of Soil Physics.
- Terzaghi K & Peck Ralph B. Soil Mechanics in Engineering Practices.

Course Objective

1. To understand the Importance of mechanics of tillage tools.
2. To get knowledge about design of tillage tools.
3. To learn about the soil dynamics and traction prediction equation.
4. To know about the test related to tillage and traction
5. To understand about the concept and application of GIS in soil dynamics.

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To Study of the Importance of mechanics of tillage tools.
CO2	Understand about the concept design of tillage tools.
CO3	Study about the soil dynamics and traction prediction equation.
CO4	Understand about the test related to tillage and traction
CO5	Understand about the concept and application of GIS in soil dynamics. .

CO-PO MAPPING:

	CO	PO1 Knowledge of Applied Science in Agricultural Engineering	PO2 Knowledge of Basic Engineering	PO3 Problem Solving	PO4 Field Experimentations	PO5 Knowledge of Soil and Water Conservation Engineering	PO6 Knowledge of Irrigation and Drainage Engineering	PO7 Knowledge of Farm Machinery, equipments and techniques	PO8 Knowledge of Process and Food Engineering equipments and techniques	PO9 Knowledge of Renewable Energy Engineering	PO10 Environment and sustainability	PO11 Ethics	PO12 Individual and team work	PO13 Communication and skill development	PO14 Lifelong learning
CO1	To understand the Importance of mechanics of tillage tools.	3	3	3	-	-	-	3	-	-	1	3	2	-	2
CO2	To get knowledge about design of tillage tools.	3	3	3	-	-	-	3	-	-	1	2	3	-	3
CO3	To learn about the soil dynamics and traction prediction equation	3	3	2	-	-	-	3	-	-	1	2	3	-	3
CO4	To know about the test related to tillage and traction	3	3	3	-	-	-	3	-	-	2	2	3	-	3
CO5	To understand about the concept and application of GIS in soil dynamics.	3	3	2	-	-	-	3	-	-	1	2	3	-	3

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Farm Machinery Design and Production
Paper Code: AE459
w.e.f. Session 2021-22

3(2+1)

Theory

Introduction to design parameters of agricultural machines & design procedure. Characteristics of farm machinery design. Research and development aspects of farm machinery. Design of standard power transmission components used in agricultural machines: mechanical & hydraulic units. Introduction to safety in power transmission. Application of design principles to the systems of selected farm machines. Critical appraisal in production of Agricultural Machinery; Advances in material used for agricultural machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques including powder metallurgy, EDM (Electro-Discharge Machining), Heat Treatment of steels including pack carburizing, shot pining process, etc. Limits, Fits & Tolerances, Jigs & Fixtures. Industrial lay-out planning, Quality production management. Reliability. Economics of process selection. Familiarization with Project Report.

Practical

Familiarization with different design aspects of farm machinery and selected components. Solving design problems on farm machines & equipment Visit to Agricultural machinery manufacturing industry, Tractor manufacturing industry Jigs and Fixtures study in relation to agricultural machinery. Fits, tolerances and limits; Layout planning of a small scale industry; Problems on Economics of process selection; Preparation of a project report; Case study for manufacturing of simple agricultural machinery.

Suggested Readings:

- Richey, C.B. Agricultural Engineering Handbook.
- Adinath M and AB Gupta. Manufacturing Technology.
- Sharma PC and DK Aggarwal. Machine Design.
- Narula V. Manufacturing process.
- Singh S. Mechanical Engineer’s Handbook. Chakrabarti NR. Data book for Machine Design.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Human Engineering and Safety
Paper Code: AE460
w.e.f. Session 2021-22

3(2+1)

Theory

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance. Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications. 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. 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, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

Practical

Calibration of the subject in the laboratory using bi-cycle ergo-meter. Study and calibration of the subject in the laboratory using mechanical treadmill; Use of respiration gas meter from human energy point of view. Use of Heart Rate Monitor. Study of general fatigue of the subject using Blink ratio method, Familiarization with electro-myograph equipment, anthropometric measurements of a selected subjects. Optimum work space layout and locations of controls for different tractors. Familiarization with the noise and vibration equipment. Familiarization with safety gadgets for various farm machines.

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.
- Astrand P. And and Rodahl K. 1977. Textbook of Work Physiology. Mc Hill Corporation, New York.
- 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-VIII
Syllabus: Tractor Design and Testing
Paper Code: AE461
w.e.f. Session 2021-22

3(2+1)

Theory

Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution, traction theory, hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors: single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings. Design of Ackerman Steering and tractor hydraulic steering. Study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc. Design of seat and controls of an agricultural tractor. Tractor Testing.

Practical

Design problem of tractor clutch – (Single/ Multiple disc clutch). Design of gear box(synchromesh/constant mesh), variable speed constant mesh drive; Selection of tractor tires – Problem solving. Problem on design of governor. Design and selection of hydraulic pump. Engine testing as per BIS code. 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. Tractors and Their Power Units.
- Raymond N, EA Yong and S Nicolas. Vehicle Traction Mechanics.
- Maleev VL. Internal Combustion Engines.
- Kirpal Singh. Automobile Engineering – Vol I and Vol II.
- Richey C.B. Agricultural Engineering Handbook.
- Mehta ML, SR Verma, SK Mishra, VK Sharma. Testing & Evaluation of Agricultural Machinery.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Hydraulic Drives and Controls
Paper Code: AE462
w.e.f. Session 2021-22

3(2+1)

Theory

Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors. Pumps, Pump Classifications, operation, performance, Displacement, Design ofGear Pumps, Vane Pumps, Piston Pumps. 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, Valve Assembly, Troubleshooting of Valves Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

Practical

Introduction to hydraulic systems. Study of hydraulic pumps, hydraulic actuators. Study of hydraulic motors, hydraulic valves, colour 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:

- Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery.
- Anthony E. Fluid Power and Applications.
- Majumdar. Oil Hydraulic System.
- Merit. Hydraulic Control Systems.
- John Deere. Fundamentals of Service Hydraulics.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Precision Agriculture and System Management
Paper Code: AE463
w.e.f. Session 2021-22

3(2+1)

Theory

Precision Agriculture – need and functional requirements. Familiarization with issues relating to natural resources. Familiarization with equipment for precision agriculture including sowing and planting machines, power sprayers, land clearing machines, laser guided land levellers, straw-chopper, straw-balers, grain combines, etc. Introduction to GIS based precision agriculture and its applications. Introduction to sensors and application of sensors for data generation. Database management. System concept. System approach in farm machinery management, problems on machinery selection, maintenance and scheduling of operations. Application to PERT and CPM for machinery system management

Practical

Familiarization with precision agriculture problems and issues. Familiarization with various machines for resource conservation. Solving problems related to various capacities, pattern efficiency, system limitation, etc. Problems related to cost analysis and inflation and problems related to selection of equipment, replacement, break-even analysis, time value of money etc.

Suggested Readings:

- Kuhar J E. The Precision Farming Guide for Agriculturist.
- Dutta SK. Soil Conservation and land management.
- Sigma and Jagmohan. Earth Moving Machinery.
- Wood and Stuart. Earth Moving Machinery.
- DeMess MN. Fundamentals of Geographic Information System.
- Hunt Donnell. Farm Power and Machinery Management.
- Sharma DN and S Mukesh. Farm Power and Machinery Management Vol I.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Food Quality and Control
Paper Code:AE464
w.e.f. Session 2021-22

3(2+1)

Theory

Basics of Food Science and Food Analysis, Concept, objectives and need of food quality. Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition. Sampling; purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials, Quality control, Quality control tools, Statistical quality control, Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality. Food adulteration and food safety. TQM and TQC, consumer preferences and acceptance, Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission),Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism.

Practical

Examination of cereals & pulses from one of go-downs and market shops in relation to FPO and BIS specifications, Detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards, Detection of adulteration and examination of spices for AGMARK and BIS standards, Detection of adulteration and examination of milk and milk products for BIS standards, Detection of adulteration and examination of fruit products such as jams, jellys, marmalades for FPO specification, Visit to quality control laboratory, Case study of statistical process control in food processing industry, Study of registration process and licensing procedure under FSSAI, Study of sampling techniques from food processing establishments, Visit to food processing laboratory and study of records and reports maintained by food processing laboratory.

Suggested Readings:

- Ranganna S. Hand book of Analysis and Quality Control for Fruit and Vegetable Products.
- Srilakshmi B, Food Science.
- Sharma Avanthi. A text book of Food Science and Technology.
- Mudambi Sumati R, Rao Shalini M and Rajagopal M.V. Food Science.
- Potter NN and Hotchkiss JH, Food Science.
- Dev Raj, Rakesh Sharma and Joshi V.K, Quality for Value Addition in Food Processing.
- The Food Safety and Standards Act along with Rules & Regulations. Commercial Law Publishers (India) Pvt. Ltd.

Course Objective

6. To understand the basic concepts of food science and importance.
7. To get knowledge about sampling, sampling techniques, procedures, statistical quality control and sensory evaluation methods.
8. To learn about the Instrumental method for testing quality of food adulteration and food safety.
9. To know about the hazards and HACCP, sanitation in food industry (SSOP), Food Laws and Regulations in India, and FSSAI.
10. To understand about the food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission),Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism.

	CO	PO1 Knowledge of Applied Science in Agricultural Engineering	PO2 Knowledge of Basic Engineering	PO3 Problem Solving	PO4 Field Experimentations	PO5 Knowledge of Soil and Water Conservation Engineering	PO6 Knowledge of Irrigation and Drainage Engineering	PO7 Knowledge of Farm Machinery, equipments and techniques	PO8 Knowledge of Process and Food Engineering equipments and techniques	PO9 Knowledge of Renewable Energy Engineering	PO10 Environment and sustainability	PO11 Ethics	PO12 Individual and team work	PO13 Communication and skill development	PO14 Lifelong learning

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To Study of the basic concepts of food science and importance
CO2	Understand about the sampling, sampling techniques, procedures, statistical quality control and sensory evaluation methods.
CO3	Study about the Instrumental method for testing quality of food adulteration and food safety
CO4	Understand about the hazards and HACCP, sanitation in food industry (SSOP), Food Laws and Regulations in India, and FSSAI
CO5	Understand about the concept of food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission),Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism..

CO-PO MAPPING:

CO1	To Study of the basic concepts of food science and importance	3	3	3	-	-	-	-	3	-	1	3	2	-	2
CO2	Understand about the sampling, sampling techniques, procedures, statistical quality control and sensory evaluation methods.	3	3	3	-	-	-	-	3	-	1	2	3	-	3
CO3	Study about the Instrumental method for testing quality of food adulteration and food safety	3	3	2	-	-	-	-	3	-	1	2	3	-	3
CO4	Understand about the hazards and HACCP, sanitation in food industry (SSOP), Food Laws and Regulations in India, and FSSAI	3	3	3	-	-	-	-	3	-	2	2	3	-	3
CO5	Understand about the concept of food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission),Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism..	3	3	2	-	-	-	-	3	-	1	2	3	-	3

3: Strong contribution, 2: average contribution, 1: Low contribution

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Food Plant Design and Management
Paper Code: AE465
w.e.f. Session 2021-22

3(2+1)

Theory

Food plant location, selection criteria, Selection of processes, plant capacity, Requirements of plant building and its components, Project design, flow diagrams, selection of equipment, process and controls, Objectives and principles of food plant layout. Salient features of processing plants for cereals, pulses, oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products. Introduction to Finance, Food Product Marketing, Food Business Analysis and Strategic Planning, Introduction to Marketing, Food Marketing Management, Supply chain management for retail food products, Entrepreneurship development in food industry, SWOT analysis, generation, incubation and commercialization of ideas and innovations, New product development process, Government schemes and incentive for promotion of entrepreneurship, Govt. policy on small and medium scale food processing enterprise, export and import policies relevant to food processing sector, procedure of obtaining license and registration under FSSAI, Cost analysis and preparation of feasibility report.

Practical

Preparation of project report, Preparation of feasibility report, Salient features and layout of pre processing house, Salient features and layout of Milk and Milk product plants, Evaluation of given layout, Salient features, design and layout of modern rice mill, Salient features, design and layout of Bakery and related product plant, Study of different types of records relating to production of a food plant, Study of different types of records relating to finance of a food plant, Study of different types of records relating to marketing of a food business, Brain storming and SWOT analysis to start a food processing business.

Suggested Readings:

- Hall, H.S. and Rosen, Y.S. Milk Plant Layout. FAO Publication, Rome.
- López Antonio. Gómez. Food Plant Design.
- Robberts Theunis C. Food plant engineering systems by, CRC Press, Washington.
- Maroulis Z B and Saravacos G D. Food plant economics. Taylor and Francis, LLC
- Mahajan M. Operations Research. Dhanpat Rai and Company Private Limited, Delhi y Maroulis Z B. Food Process Design. Marcel Dekker, Inc ,Cimarron Road, Monticello, New York 12701, USA. 19.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Food Packaging Technology
Paper Code: AE466
w.e.f. Session 2021-22

3(2+1)

Theory

Factors affecting shelf life of food material during storage, Interactions of spoilage agents with environmental factors as water, oxygen, light, pH, etc. and general principles of control of the spoilage agents; Difference between food infection, food intoxication and allergy. Packaging of foods, requirement, importance and scope, frame work of packaging strategy, environmental considerations, Packaging systems, types: flexible and rigid; retail and bulk; levels of packaging; special solutions and packaging machines, technical packaging systems and data management packaging systems, Different types of packaging materials, their key properties and applications, Metal cans, manufacture of two piece and three piece cans, Plastic packaging, different types of polymers used in food packaging and their barrier properties. manufacture of plastic packaging materials, profile extrusion, blown film/ sheet extrusion, blow molding, extrusion blow molding, injection blow molding, stretch blow molding, injection molding. Glass containers, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers. Paper and paper board packaging, paper and paper board manufacture process, modification of barrier properties and characteristics of paper/ boards. Relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities. Nutritional labelling on packages, CAS and MAP, shrink and cling packaging, vacuum and gas packaging; Active packaging, Smart packaging, Packaging requirement for raw and processed foods, and their selection of packaging materials, Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste, Printing and labelling, Lamination, Package testing: Testing methods for flexible materials, rigid materials and semi rigid materials; Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply 202 203 Report of the ICAR Fifth Deans' Committee Report of the ICAR Fifth Deans' Committee bond test, surface oil absorption test, etc.), plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.).

Practical

Identification of different types of packaging materials, Determination of tensile/ compressive strength of given material/package, To perform different destructive and 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 and 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-VIII
Syllabus: Development of Processed Products
Paper Code: AE467
w.e.f. Session 2021-22

3(2+1)

Theory

Process design, Process flow chart with mass and energy balance, Unit operations and equipments for processing, New product development, Technology for value added products from cereal, pulses and oil seeds, Milling, puffing, flaking, Roasting, Bakery products, snack food. Extruded products, oil extraction and refining, Technology for value added products from fruits, vegetables and spices, Canned foods, Frozen foods, dried and fried foods, Fruit juices, Sauce, Sugar based confection, Candy, Fermented food product, spice extracts, Technology for animal produce processing , meat, poultry, fish, egg products, Health food, Nutra-ceuticals and functional food, Organic food.

Practical

Process design and process flow chart preparation, preparation of different value added products, Visit to roller wheat flour milling, rice milling, spice grinding mill, milk plant, dal and oil mill, fruit/vegetable processing plants & study of operations and machinery, Process flow 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. y Rao, D. G. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
- Norman N. Potter and Joseph H. Hotchikss. 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.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Process Equipment Design
Paper Code: AE468
w.e.f. Session 2021-22

3(2+1)

Theory

Introduction on process equipment design, Application of design engineering for processing equipments, Design parameters and general design procedure, Material specification, Types of material for process equipments, Design codes, Pressure vessel design, Design of cleaners. Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger, Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipments. Optimization of design with respect to process efficiency, energy and cost, Computer Aided Design.

Practical Design of pressure vessel, cleaners, milling equipments, tubular heat exchanger, shell and tube type heat exchanger, plate heat exchanger, dryer, belt conveyor, bucket elevator, screw conveyor.

Suggested Readings:

- 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-VIII
Syllabus: Photovoltaic Technology and Systems
Paper Code: AE469
w.e.f. Session 2021-22

3(2+1)

Theory

Solar PV Technology: Advantages, Limitations, Current Status of PV technology, SWOT analysis of PV technology. Types of Solar Cell, Wafer based Silicon Cell, Thin film amorphous silicon cell Thin Cadmium Telluride (CdTe) Cell, Copper Indium Gallium Selenide (CiGS) Cell, Thin film crystalline silicon solar cell. Solar Photo Voltaic Module: Solar cell, solar module, solar array, series & parallel connections of cell, mismatch in cell, fill factor, effect of solar radiation and temperature on power output of module, I-V and power curve of module. Balance of Solar PV system: Introduction to batteries, battery classification, lead acid battery, Nicked Cadmium battery, comparison of batteries, battery parameters, Charge controller: types of charge controller, function of charge controller, PWM type, MPPT type charge controller, Converters: DC to DC converter and DC to AC type converter. Application of Solar PV system. Solar home lighting system, solar lantern, solar fencing, solar street light, solar water pumping system, Roof top solar photovoltaic power plant and smart grid.

Practical

Study of V-I characteristics of solar PV system, smart grid technology and application, manufacturing technique of solar array, different DC to DC and DC to AC converter, domestic solar lighting system, various solar module technologies, safe measurement of PV modules electrical characteristics and Commissioning of complete solar PV system.

Suggested Readings:

- Rai GD. 1998. Non-conventional Sources of Energy. Khanna Pub.
- Rathore N.S., Kurchania A.K., Panwar N.L. 2006. Renewable Energy: Theory & Practice, Himanshu Publications,.
- Solanki C.S. 2011. Solar Photovoltaic: Fundamentals, Technologies and Applications, PHI Learning Private Ltd.
- Meinel & Meinel. Applied Solar Energy.
- Derrick, Francis and Bokalders, Solar Photo-voltaic Products.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Waste and By-Products Utilization
Paper Code:AE470
w.e.f. Session 2021-22

3(2+1)

Theory

Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc., 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, 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, Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, 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, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards.

Practical

Determination of temperature, pH, turbidity solids content, BOD and COD of waste water, Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash, Study about briquetting of agricultural residues, Estimation of excess air for better combustion of briquettes, Study of extraction of oil from rice bran, Study on bioconversion of agricultural wastes, Recovery of germ and germ oil from by-products of cereals, Visit to various industries using waste and food by-products.

Suggested Readings:

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

Course Objective

1. To understand the Importance of by-products from agriculture and its importance.

2. To get knowledge about Concept, scope and maintenance of waste management and effluent treatment.
3. To learn about the Waste utilization in various industries.
4. To know about the biomass and its utilization and importance.
5. To understand about the concept of advanced waste water treatment.

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To Study of the Importance of by-products from agriculture and its importance
CO2	Understand about the concept about Concept, scope and maintenance of waste management and effluent treatment
CO3	Study about the Waste utilization in various industries
CO4	Understand about the biomass and its utilization and importance
CO5	Understand about the concept of advanced waste water treatment.

CO-PO MAPPING:

	CO	PO1 Knowledge of Applied Science in Agricultural Engineering	PO2 Knowledge of Basic Engineering	PO3 Problem Solving	PO4 Field Experimentations	PO5 Knowledge of Soil and Water Conservation Engineering	PO6 Knowledge of Irrigation and Drainage Engineering	PO7 Knowledge of Farm Machinery, equipments and techniques	PO8 Knowledge of Process and Food Engineering equipments and techniques	PO9 Knowledge of Renewable Energy Engineering	PO10 Environment and sustainability	PO11 Ethics	PO12 Individual and team work	PO13 Communication and skill development	PO14 Lifelong learning
CO1	To understand the Importance of by-products from agriculture and its importance.	3	3	3	-	-	-	-	3	-	1	3	2	-	2
CO2	To get knowledge about Concept, scope and maintenance of waste management and effluent treatment.	3	3	3	-	-	-	-	3	-	1	2	3	-	3
CO3	To learn about the Waste utilization in various industries.	3	3	2	-	-	-	-	3	-	1	2	3	-	3
CO4	Understand about the biomass and its utilization and importance	3	3	3	-	-	-	-	3	-	2	2	3	-	3
CO5	Understand about the concept of advanced waste water treatment.	3	3	2	-	-	-	-	3	-	1	2	3	-	3

3: Strong contribution, 2: average contribution, 1: Low contribution

B.Tech. (Agricultural Engineering)
SEMESTER-VIII
Syllabus: Artificial Intelligence
Paper Code: AE471
w.e.f. Session 2021-22

3(3+0)

Theory

Foundation and history of artificial intelligent, problems and techniques – AI programming languages, introduction to LISP and PROLOG- problem spaces and searches, blind search strategies, Breadth first- Depth first- heuristic search techniques Hill climbing: best first-A* algorithm AO* algorithm- game tree, Min max algorithms, game playing- alpha beta pruning. Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Baye's probabilistic interferences and Dempster shafer theory, Heuristic methods, symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non monotonic reasoning. Planning and planning in situational calculus, representation for planning, partial order planning algorithm, learning from examples, discovery as learning, learning by analogy, explanation based learning, neural nets, genetic algorithms. Principles of Natural language processing, rule based systems architecture, Expert systems, knowledge acquisition concepts, AI application to robotics, and current trends in intelligent systems.

Suggested Readings:

- Russell, S. and P. Norvig. 1998. Artificial Intelligence: A Modern Approach. Prentice Hall.
- Rich, Elain and Kevin Knight. 1991. Artificial Intelligence. TMH.
- Patrick Henry Winston. 1992. Artificial intelligence. Addition Wesley 3 rd Ed.
- Nilson Nils J. Principles of Artificial Intelligence. Norsa Publishing House.

B.Tech. (Agricultural Engineering)
SEMESTER-VIII

Syllabus: Mechatronics
Paper Code: AE472
w.e.f. Session 2021-22

3(2+1)

Theory

Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach. Sensors and transducers, performance terminology, Displacement, Position & Proximity Sensors, photo-electric transducers, flow transducers, optical sensors and transducers. Actuators, Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor. Signal conditioning process, filtering digital signal, multiplexers, data acquisition, digital signal processing, measurement system, pulse modulation, data presentation systems. System modelling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulic mechanical Systems, Modelling Dynamic Systems, Transfer Functions, Control Modes, PID Controller. Micro-processor & computer, Computer and Interfacing, Micro-computer Structure, Micro-controllers, Application of Microcontrollers, PLC. Robotics, Robot components, robot classification and specification, Work envelopes, other basic parameters of robots. Robot applications, Robot applications in manufacturing, Material transfer and machine loading/ unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Future applications.

Practical

Selection of sensor for a particular application from Catalogue/Internet. Design a mechatronics product/system and incorporate application of mechatronics for enhancing product values. To study the hardware and software of mechatronics kit. To move a table in X-direction within the range of proximity sensors using Control-X software. To run a motor with PLC. To run a conveyor with computer. To study the movement of actuating cylinders and sensors.

Suggested Readings:

- Bolton, W. Mechatronics. Pearson Education Asia.
- Wolfram, Stadler. Analytical Robotics and Mechatronics. Mc-Graw Hill.
- Doeblin E.O. Measurement Systems. Mc-Graw Hill.
- Mahind, A.P. Introduction to Digital Computer Electronics. TMH.
- Niku, S.Y. Introduction to Robotics: Analysis, systems and applications", Pearson Education Asia.
- Craig, J.J. Introduction to Robotics. Pearson Education Asia.