Semester - VII

S.No.	Course Name	Course No.	Credit
1	**Project**	**AE - 401**	**6**
2	**Seminar**	**AE - 403**	**1**

S No.	Course Name	Course No.	Credit	L	P	T
3	**Renewable Energy Technology**	**RE - 401**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:
Design and operational parameters, performance evaluation and maintenance aspects of different renewable technologies like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays, briquetting machines and balers; bio-diesel utilization in CI engines.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Design and operational parameters	2
2	performance evaluation and maintenance aspects of gasifiers,	6
3	performance evaluation and maintenance aspects of biogas plants,	4
4	Performance evaluation and maintenance aspects of solar passive heating devices,	5
5	Performance evaluation and maintenance aspects of photovoltaic cells and arrays,	5
6	Performance evaluation and maintenance aspects of briquetting machines and balers	5
7	Bio diesel utilization in CI engines.	5
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Performance evaluation of solar water heater	2
2	Performance evaluation of solar cooker	2
3	Characteristics of solar photovoltaic panel	1
4	Evaluation of solar air heater/dryer	1
5	Performance evaluation of a rice husk throatless gasifier engine system	2
6	Performance evaluation of down draft gasifier with throat for thermal application	1
7	Performance evaluation of a fixed dome type biogas plant	1
8	Performance evaluation of floating drum type biogas plant	1
9	Estimation of calorific value of producer gas	1

10	Testing of diesel engine operation using biodiesel	1
11	Evaluation of briquetting machine using biomass material; evaluation of rice straw briquette.	2
	Total	**15**

Reference Books

- Renewable Energy: Power for sustainable future , By: Godfrey Boyle.
- Energy Technology: Non-conventional, Renewable and Conventional , By: S.S. Rao and B.B. Parulekar
- Handbook of Biomass Downdraft Gasifier Engine System, By: Thomas B Reed and Aqua Das.
- Small scale producer gas engine systems, By: A Kaupp & J. R. Goss.
- Biogas Systems (Principles & Applications) , By: K.M. Mittal,
- Hand book of biogas technology, By: N.S. Grewal, S. Ahluwalia, S. Singh and G. Singh.
- Solar Energy Fundamentals and Applications, By: H.P. Garg and J. Prakash,
- Solar energy, By: S.P. Sukhatme,
- Principles of Solar Energy. , By: D. Yogi Goswami *et al.*
- Renewable Energy , By: P.D. Dunn. Peter Peregrinus Ltd., London.

Student will have to take minimum of 15 credits courses from the following Cafeteria Courses :

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Food Packaging Technology**	**PFE - 401**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Factors affecting shelf life of food material during storage; spoilage mechanism during storage.	4
2	Definition, requirement, importance and scope of packaging of foods; types and classification of packaging system; advantage of modern packaging system.	4
3	Different types of packaging materials used.	4
4	Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink packaging, vacuum & gas packaging.	5
5	Packaging requirement & their selection for the raw & processed foods.	3

6	Advantages & disadvantages of these packaging materials; effect of these materials on packed commodities.	3
7	Package testing.	2
8	Printing, labeling and lamination.	2
9	Economics of packaging.	2
10	Performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements.	3
11	Disposal and recycle of packaging waste.	2
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Identification of different types of packaging materials.	1
2	Determination of tensile strength of given material	1
3	Determination of compressive strength of given package	1
4	To perform different destructive tests for glass containers	1
5	To perform non-destructive tests for glass containers	1
6	Vacuum packaging of agricultural produces	1
7	Determination of tearing strength of paper board	1
8	Measurement of thickness of packaging materials	1
9	To perform grease-resistance test in plastic pouches	1
10	Determination of bursting strength of packaging material	1
11	Determination of water-vapour transmission rate	1
12	Shrink wrapping of various horticultural produce	1
13	Testing of chemical resistance of packaging materials.	1
14	Determination of drop test of food package	1
15	Visit to relevant industries	1
	Total	**15**

Reference Books

- Handling and storage of food grains in tropical and suntropical areas , By: Hall, C. W.
- Preservation and storage of grains, seeds and their by-products , By: Multon J.L.
- Food packaging materials. , By: Mahadeviah, M. and R. V .Gowramma.
- Post harvest physiology, handling and utilization of tropical and sub tropical fruits and vegetables. , By: Pantastico,, E.C.B.
- Agricultural process engineering , By: Handerson, S. and Perry, S.M.
- Post harvest handling-A systems approach. , By: Shewfelt, R.L. and Prussi., S.E.

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	**Design and Maintenance of Greenhouse**	**RE - 403**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	History and types of greenhouse	1
2	Function and features of greenhouse ,	1
3	Scope and development of greenhouse technology	1
4	Location, planning and various components of greenhouse,	1
5	Design criteria and calculations	3
6	Construction materials and methods of construction	2
7	Covering material and characteristics	1
8	Solar heat transfer	2
9	Solar fraction for greenhouse	2
10	Steady state analysis of greenhouse	2
11	Greenhouse heating, cooling, shedding and ventilation system	2
12	Carbon dioxide generation and monitoring and lighting systems	1
13	Instrumentation and & computerized environmental control systems	2
14	Watering, fertilization, root substrate and pasteurization	1
15	Containers and benches	1
16	Plant nutrition, Alternative cropping systems	1
17	Plant tissue culture	2
18	Chemical growth regulation	1
19	Disease control, integrated pest management,	1
20	Post production quality and handling	2
21	Cost analysis of greenhouse production,	1
22	Application of greenhouse & its repair & maintenance	1
	Total	**32**

Practicals		
S.No.	Topic	No. of Practicals
1	Study / visit to a functional green house; planning and layout of green house & associated utilities	2
2	Material selection for the construction of green house Economic analysis of green house; Visit to a commercial green house	2
3	Measurement of temp. using thermometer, thermistor & thermocouples inside the green house	1
4	Measurement of humidity & air velocity using various methods	1
5	Measurement of solar radiations inside the green house	1
6	Application of psychometric charts; estimation of cooling requirements in a green house; estimation of ventilation requirements	2
7	Thermal performance of green house	1
8	Application of data loggers for simultaneous estimation & control of different parameters like temp., RH, solar radiations etc	2
9	Calculations of environment indices inside a green house	1
10	Structural analysis of green house	2
	Total	**15**

Reference Books

- Solar Engineering Thermal Process. , By: Duffie J.A. and Beckman W.A.
- Greenhouse Advanced Technology , By: Hanan
- Greenhouse Operation & Management. , By: Nelson P.V.
- Handbook of Greenhouse technology, By: Radhamanohar
- Greenhouse Technology , By: Tiwari G.N. and Goyal R.K.

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	**Waste and Byproduct Utilization**	**PFE - 403**	**2 (1 + 1)**	**1**	**1**	**0**

Course content :

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

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Types and formation of byproducts and waste; magnitude of waste generation in different food processing industries.	1
2	Concept scope and maintenance of waste management and effluent treatment.	2
3	Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters.	2
4	Microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues.	1
5	Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette.	2
6	Generation of electricity using surplus biomass, producer gas generation and utilization.	1
7	Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting.	2
8	Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments.	1
9	Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments.	2
10	Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal.	2
11	Assessment, treatment and disposal of solid waste; and biogas generation.	1
	Total	**17**

Practicals		
S.No.	Topic	No. of Practicals
1	Waste characterization: (a) temperature (b) pH (c) solids content (d) turbidity (e) BOD (f) COD.	1
2	Determination of ash content of agricultural wastes.	1
3	Determination of un-burnt carbon in ash of paddy straw.	1
4	To study about briquetting of agricultural residues.	1
5	Estimation of excess air for better combustion of briquettes.	1
6	To study about extraction of oil from rice bran.	1
7	To study about waste treatment plant in food industry.	1
8	To study about utilization of whey.	1
9	To study about recovery of peel oil.	1
10	To study about recovery of germ and germ oil from by-product of cereals.	1
11	Practical on bioconversion of agro-wastes.	1
12	Practical on recycling of agro-wastes and by-products.	1
13	Visits to various industries using waste and food byproducts.	1
	Total	**13**

Reference Books

- Manure Production and Characteristics , By: ASAE Standards (1984).
- Managing Livestock Waste. , By: Markel, I. A. (1981).
- Agricultural Waste Management Field Handbook. , By: USDA (1992).
- Compost Engineering: Principles and Practices. , By: Huang, R.T.

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Development of Processed Products and Equipments**	**PFE - 405**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Applications of unit operations to the food industry.	2
2	Analytical processing concepts with regards to mass and energy balances.	2
3	Equipment involved in the commercially important food processing methods and unit operations.	3
4	Value addition to cereals like rice, wheat etc.	2
5	Parboiling of rice, quality of processed products of rice & wheat.	2
6	Processing of pulses, spices and condiments.	2
7	Extruded food product, fermented food product, frozen and dried product.	2
8	Technology of meat, fish and poultry products.	2
9	Technology of milk and milk products.	2
10	Fruits and vegetables product: candy, nutraceuticals, snack foods.	2
11	Food product development trends.	1
12	Food additives and labeling.	1
13	Process equipment for thermal processing-evaporation, dehydration, drying, blenching, Pasteurization, distillation.	4
14	Process equipment for mechanical separation-filtration, sieving, centrifugation, sedimentation;	3
15	Process equipment for mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.	4
	Total	**34**

Practicals		
S.No.	Topic	No. of Practicals
1	Working principle and operation of Engleberg huller	1
2	Study of different cleaners and graders used in agro processing industries	2
3	Working principle, operation and maintenance of paddy destoner-cum-cleaner, rubber roll sheller, paddy separator and vertical cone whitener	3
4	Familiarization with operation and performance of machinery and equipments of Satake rice milling unit of 500 kg/hr.	1
5	Planning and layout of roller wheat flour milling & rice milling	1
6	Visit to milk plant	1
7	Visit to roller flour mill	1
8	Visit to mark fed canneriesill	1
9	Visit to fruit/vegetable processing plants	2
10	Flow process diagram and study of various models of the machines used in a sugar m	2
	Total	**15**

Reference Books

- Unit operations of Agricultural Processing, By: Sahay, K. M. & K.K. Singh.
- Post harvest technology of cereals, pulses and oilseeds , By: Chakraverty, A.

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	**Food Processing Plant Design and Layout**	**PFE - 407**	**2 (1 + 1)**	**1**	**1**	**0**

Course content:

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

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Meaning and definition of plant layout.	1
2	Objectives and principles of layout. Types of layout.	1
3	Salient features of processing plants for cereals, pulses oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products.	3
4	Location selection criteria.	1
5	Selection of processes, plant capacity, project design, flow diagrams	2

6	Selection of equipments, process and controls, handling equipments.	2
7	Plant layout, plant elevation.	1
8	Requirement of plant building and its components, sanitation.	1
9	Labour requirement.	1
10	Plant installation.	1
11	Power and power transmission.	1
	Cost analysis, preparation of feasibility report.	2
	Total	**17**

Practicals

S.No.	Topic	No. of Practicals
1	Planning, visit and layout of flour milling plant.	1
2	Planning, visit and layout of rice milling plant.	1
3	Planning, visit and layout of milk plant.	1
4	Planning, visit and layout of bakery plant	1
5	Planning, visit and layout of honey/turmeric/chillies processing	3
6	Planning, visit and layout of fruits and vegetable dehydration plant.	2
7	Planning, visit and layout of beverages industry.	1
8	Planning, visit and layout of edible of extraction plant.	2
9	Planning, visit and layout of ice-cream plant	1
10	Planning, visit and layout of sugar mill plant.	2
		15

Reference Books

- Physical Properties of foods and food processing systems , By: Lewis, M.J.
- Dairy technology and engineering , By: Harper, W.J. and Hall, C.W.
- Mass Transfer Operations, By: Treybal, R. E.
- Process Modeling Simulation and Control for Chemical Engineers, By: Luyben , W.L.

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Micro Irrigation System Design**	**SWE - 401**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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, 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. 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. 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Past, present and future need of micro-irrigation systems.	2

2	Role of Govt. for the promotion of micro-irrigation in India.	1
3	Merits and demerits of micro-irrigation system.	1
4	Types and components of micro-irrigation system.	2
5	Micro-irrigation system- design, design synthesis, installation, and maintenance.	4
6	Sprinkler irrigation - types, planning factors, uniformity and efficiency.	4
7	Laying pipeline, hydraulic lateral, sub-mains and main line design, pump and power unit selection.	4
8	Drip irrigation – potential, automation, crops suitability.	4
9	Fertigation – Fertilizer application criteria, suitability of fertilizer compounds, fertilizer mixing, injection duration, rate and frequency, capacity of fertilizer tank.	3
10	Quality control in micro-irrigation components.	3
11	Design and maintenance of polyhouse; prospects, waste land development – hills, semi-arid, coastal areas, water scarce areas, Benefit and Cost analysis.	6
	Total	**34**
Practicals		
S.No.	Topic	No. of Practicals
1	Study of different types of micro-irrigation systems and components; Field visit of micro-irrigation system;	2
2	Study of water filtration unit; Discharge measurement study of different micro-irrigation systems;	2
3	Study of water distribution and uniformity coefficient;	2
4	Study of wetted front and moisture distribution under various sources of micro-irrigation system;	2
5	Design of micro-irrigation system for an orchard;	1
6	Design of micro-irrigation system for row crops design of spray type micro-irrigation system;	1
7	Design of micro-irrigation system for hilly terraced land; Study of automation in micro-irrigation system;	2
8	Study of micro climate inside a Polyhouse	1
9	Study of maintenance and cleaning of different components of various systems;	2
10	Design of sprinkler irrigation system; Design of landscape irrigation system	2
	Total	**17**

Reference Books

- Principles of Sprinkler Irrigation, By: M S Mane, B L Ayare,
- Principles of drip irrigation System , By: M S Mane, B L Ayare, S S Magar
- Text Book of Irrigation Engineering and Drainage, By: R.K. Sharma and T.K. Sharma
- Irrigation Engineering, By: R. Lal
- Sprinkler Irrigation, By: R.K. Sivanappan
- Irrigation Principles and Practices, By: O.W. Israelsen, V.T. Hansen and Stringhem
- Irrigation System : Design and Operation, By:D. Karmeli, G. Peri and M. Todes

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	**Watershed Planning and Management**	**SWE - 403**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Watershed management - problems and prospects; watershed based land use planning, watershed characteristics – physical and geomorphologic, factors affecting watershed management, hydrologic data for watershed planning, watershed delineation, delineation of priority watershed, water yield assessment and measurement from a watershed; 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; 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Watershed management - problems and prospects.	2
2	Watershed based land use planning.	2
3	watershed characteristics – physical and geomorphologic, factors affecting watershed management.	3
4	Hydrologic data for watershed planning.	2
5	Watershed delineation, delineation of priority watershed.	2
6	Water yield assessment and measurement from a watershed.	2
7	Hydrologic and hydraulic design of earthen embankments and diversion structures.	3
8	Sediment yield estimation and measurement from a watershed and sediment yield models.	2
9	Rainwater conservation technologies - in-situ and storage, design of water harvesting tanks and ponds.	3
10	Water budgeting in a watershed.	2
11	Effect of cropping system, land management and cultural practices on watershed hydrology.	2
12	Evaluation and monitoring of watershed programmes.	2
13	People's participation in watershed management programmes.	2
14	Planning and formulation of project proposal; cost benefits analysis of watershed programmes.	3
15	Optimal land use models; case studies.	2
	Total	**34**

Practicals		
S.No.	Topic	No. of Practicals
1	Study of watershed characteristic; analysis of hydrologic data for watershed management;	2
2	Delineation of watershed and measurement of area under different vegetative and topographic conditions;	2
3	Measurement of water and sediment yield from watershed;	2
4	Study of different watershed management structures;	3
5	Study of various water budget parameters; .	2
6	Study of watershed management technologies;	3
7	Preparation of a techno-economically effective project proposal	3
	Total	**17**

Reference Books

- Watershed Management (For Dryland Agriculture) , By: Oswal M.C.
- Land Resources and Their Management for Sustainability in Arid Regions , By: Kolarkar A.S.
- Land and Water Management Engineering , By: V.V.N. Murthy
- Design of small canal structures , By: Aisenbrey A.J., Hayes R.B., Warren H.J., Winsett D.L. & Young R.B.
- Textbook of Irrigation Engineering and Hydraulic Structures , By: R.K. Sharma
- River Basin Planning, Theory and Practices, By: Saha S.K. & Barrow C.J.
- Studies in Irrigation and Water Management B.D. Dhawan
- Watershed planning and management , By: Rajvir Singh

Sr. No.	Course Name	Course No.	Credit	L	P	T
8	**Minor Irrigation and Command area Development**	**SWE - 405**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Major, medium and minor irrigation projects – their comparative performance; development and utilization of water resources through different minor irrigation schemes. 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. Planning and execution of on farm development activities with in 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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Major, medium and minor irrigation projects – their comparative performance.	4
2	Development and utilization of water resources through different minor irrigation schemes.	4
3	Basic concepts of command area definition.	2
4	Need, scope, and development approaches.	3

5	Historical perspective, command area development authorities.	2
6	Interaction/collaboration of irrigation water use efficiency and agricultural production.	4
7	Planning and execution of on farm development activities within the scope of command area development.	4
8	Use of remote sensing techniques for command area development.	4
9	Case studies of some selected commands.	4
10	Farmer's participation in command area development.	3
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Topographic survey and preparation of contour map.	2
2	Preparation of command area development layout plan;	1
3	Land leveling design for a field;	1
4	Earthwork and cost estimation.	1
5	Irrigation water requirement of crops;	1
6	Preparation of irrigation schedules; .	1
7	Planning and layout of water conveyance system;	1
8	Design of Irrigation systems	2
9	Conjunctive water use planning;	1
10	Application of remote sensing for command area development;	2
11	Technical Feasibility and economic viability of a command area project.	2
12	Study tour to minor irrigation and command area development projects	2
	Total	**17**

Reference Books

- Principles of farm irrigation System design, L G James,
- Irrigation Hydraulics, By: R Lal,
- Hydrologic Modelling of Small watersheds , By: Haan, C T
- Land and Water Management Engineering, By: V.V.N. Murthy
- Design of small canal structures , By: Aisenbrey A.J., Hayes R.B., Warren H.J., Winsett D.L. & Young R.B.
- Textbook of Irrigation Engineering and Hydraulic Structures, By: R.K. Sharma
- Studies in Irrigation and Water Management, By: B.D. Dhawan
- Irrigation System : Design and Operation, By: D. Karmeli, G. Peri and M. Todes

Sr. No.	Course Name	Course No.	Credit	L	P	T
9	**Gully and Ravine Control Structures**	**SWE - 407**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Introduction; 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 methods of flood control measures, storage and detention reservoirs, levees, channel improvement; Gulley erosion and its control; soil erosion and sediment control measures; river training works, planning of flood control projects and their economics.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction; floods - causes of occurrence.	2
2	Flood classification - probable maximum flood, standard project flood, design flood.	4
3	Flood estimation - methods of estimation; estimation of flood peak - Rational method, empirical methods.	3
4	Unit hydrograph method.	2
5	Statistics in hydrology, flood frequency methods - Log normal, Gumbel' s extreme value, Log-Pearson type-III distribution.	4
6	Depth-area-duration analysis.	2
7	Flood forecasting, flood routing - channel routing, Muskingum method.	3
8	Reservoir routing, modified Pul's method.	2
9	Flood control, history of flood control, structural and non-structural methods of flood control measures.	3
10	Storage and detention reservoirs, levees, channel improvement.	2
11	Gulley erosion and its control, soil erosion and sediment control measures;	3
12	River training works, planning of flood control projects and their economics.	4
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Determination of flood stage-discharge relationship in a watershed.	1
2	Determination of flood peak-area relationships.	1
3	Determination of frequency distribution functions for extreme flood values using Gumbel' s method.	2
4	Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution.	2
5	Determination of confidence limits of the flood peak estimates for Gumbel' s extreme value distribution.	2
6	Determination of probable maximum flood.	1

7	Standard project flood and spillway design flood;	1
8	Design of levees for flood control.	1
9	Design of jetties.	1
10	Study of vegetative and structural measures for Gulley stabilization.	2
11	Designing and planning of a flood control project.	1
12	Cost and benefit analysis of a flood control project.	2
	Total	**17**

Reference Books

- Manual of Soil and water conservation practices, By: Gurmel Singh, Vekataraman, Sasry G., Joshi B P
- Design of Small Canal Structures, By: Aisenbrey A. J., Hayes R.B., Warren H. J., Winsett D. L. & Young R. B.
- River Basin Planning, Theory and Practices, By: Saha S. K. & Barrow C. J.
- Important Aspects of River Valley Project (Vol. I, II, III & IV) , By: J. F. Mistry

Sr. No.	Course Name	Course No.	Credit	L	P	T
10	**Remote Sensing & GIS Applications**	**SWE - 409**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Remote Sensing: Definition, stage in remote sensing, modern remote sensing technology versus conventional aerial photography; visual image interpretation.	2
2	Image interpretation, basic principles of image interpretation, factors governing the quality of an image.	2
3	Factors governing interpretability, visibility of objects, elements of image interpretation, techniques of image interpretation.	2
4	Digital image processing, digital image; remote sensing in agriculture progress and prospects.	4
5	Microwave radiometry for monitoring agriculture crops and hydrologic forecasting.	2
6	Arial photo interpretation for water resources development and soil conservation survey.	4
7	GIS: History of development of GIS definition.	2
8	Basic components, and standard GIS packages.	2

9	Data-entry, storage and maintenance.	2
10	Data types-spatial-non-spatial (attribute data).	4
11	Data structure, data format- point line vector-raster–polygon-object structural model.	4
12	Files, files organization-data base management systems (DBMS), entering data in computer digitizer- scanner-data compression.	4
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Familiarization with remote sensing and GIS hardware;	1
2	Use of instruments for aerial photo interpretation;	2
3	Interpretation of aerial photographs and satellite imagery;	2
4	Basic GIS operations such as image display;	2
5	Study the various features of GIS software package;	3
6	Scanning and digitization of maps;	2
7	Data base query and map algebra;	2
8	GIS supported case studies in water resources management	3
	Total	**17**

Reference Books

- Principles of Remote Sensing, By: A.N. Patel & Surendra Singh
- Remote Sensing and Geographic Information Systems in Irrigation and Drainage :
- Methodological Guide and Applications (International Commission on Irrigation and Drainage) - Alain Vidal (Editor)
- Advances in Remote Sensing & GIS Analysis, By: Atkinson P.M.
- Introduction to Remote Sensing , By: James B. Campbell
- Manual of Remote Sensing Vol. I & II , By: Colwell R.N
- Remote Sensing : Principles and Interpretation , By: Sabins F.L
- Geographic Information Systems, By: Antenucci J.C., Brown K., Croswell P.L., Kevary M.J

Sr. No.	Course Name	Course No.	Credit	L	P	T
11	**System Engineering**	**SWE - 413**	**3 (3 + 0)**	**3**	**0**	**0**

Course content :

System concepts. Requirements for a Linear programming problems. Mathematical formulation of Linear Programming problems and its Graphical solution. Response of systems. Computer as a tool in system analysis. Simplex method. Degeneracy and Duality in linear programming. Artificial variable techniques, Big M method and two phase methods. Mathematical models of physical systems. Modeling of Agricultural Systems and operations. Cost analysis. Transportation problems. Assignment problems. Waiting line problems. Project management by PERT/CPM. Resource scheduling.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	System concepts.	3
2	Requirements for a Linear programming problems.	3
3	Mathematical formulation of Linear Programming problems and its Graphical solution.	4
4	Response of systems. Computer as a tool in system analysis.	3
5	Simplex method. Degeneracy and Duality in linear programming.	4
6	Artificial variable techniques, Big M method and two phase methods.	4
7	Mathematical models of physical systems.	4
8	Modeling of Agricultural Systems and operations.	4
9	Cost analysis.	3
10	Transportation problems.	3
11	Assignment problems.	3
12	Waiting line problems.	3
13	Project management by PERT/CPM.	5
14	Resource scheduling.	5
	Total	**51**

Reference Books /

- Operations research, By: P K Gupta,& Hira , D.S
- Optimization-Theory & Applications, By: S S Rao
- Operations research, By: A P Verma
- Operations research , By: Kanti Swarup, Gupta, P K and Man Mohan
- Operations research, By: P K Gupta, & Hira , D. S
- Operations research, By: Mittal and Goel
- Operations research: An Introduction, By: H A Taha

Sr. No.	Course Name	Course No.	Credit	L	P	T
12	**Reservoir and Farm Pond Design**	**SWE - 411**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

Earthen embankments - functions, advantages and disadvantages, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type; 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, 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 slice method; types of reservoirs and farm ponds, design and estimation of earth work; cost analysis.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Earthen embankments - functions, advantages and disadvantages	2
2	Classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type	3
3	Foundation requirements, grouting	2
4	Seepage through dams - estimation of seepage discharge, location of seepage/phreatic line by graphical and analytical methods	3
5	Flow-net and its properties, seepage pressure, seepage line in composite earth embankments	4
6	Drainage filters, piping and its causes	2
7	Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc.	7
8	Stability of slopes - analysis of failure by slice method	3
9	Types of reservoirs and farm ponds	2
10	Design and estimation of earth work; cost analysis	4
	Total	**32**

Practicals		
S.No.	Topic	No. of Practicals
1	Study of different types and materials of earthen dams	1
2	Determination of the position of phreatic line in earth dams for various conditions	2
3	Stability analysis of earthen dams against head water pressure	1
4	Stability analysis of earthen dams against foundation shear	1
5	Stability analysis of earth dams against sudden draw down condition	1
6	Stability of slopes of earth dams by friction circle method / different methods; Construction of flow net for isotropic and anisotropic medium	3
7	Computation of seepage by different methods	1
8	Determination of settlement of earth dam	1
9	Input-output-storage relationships by reservoir routing	1
10	Design of farm ponds	1
11	Cost estimation of farm ponds and other structures.	2
	Total	**15**

Reference Books

- Soil and water Conservation engineering , By: R Suresh,
- Manual of Soil and Water Conservation Practices, By: Gurmel Singh, C. Venkatraman, C. Sastry and B.P. Joshi
- The flow of homogeneous fluids through porous media , By: Muskat M
- Flow of fluids through porous materials , By: Collins , R.E
- Hydrologic Modelling of Small watersheds , By: Haan, C T
- Soil and water Conservation Engineering , By: Scwab, G.o, Frevert, R.K. and Edminister

Sr. No.	Course Name	Course No.	Credit	L	P	T
13	**Tractor Design and Testing**	**FMP - 401**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution, hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors. Design of Ackerman Steering and tractor hydraulic systems. Study of special design features of tractor engines and their selection. Design of seat and controls of an agricultural tractor. Tractor Testing.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Procedure for design and development of agril. Tractor	3
2	Study of parameters for balanced design of tractor for stability and weight distribution	4
3	Hydraulic lift and hitch system design	3
4	Design of mechanical power transmission in agril. Tractor	4
5	Design of Ackerman steering and tractor hydraulic systems	3
6	Study of special design features of tractor engines and their selection	2
7	Design of seat and control of an agril. Tractors	5
8	Tractor testing	4
9	General revision	4
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Design problems of tractor clutch (single / multiple disc clutch)	2
2	Design problem on spur gears and bevel gears	1
3	Design problem of helical gears	1
4	Design of gear box (synchromesh / constant mesh), design of variable speed constant mesh drive	2
5	Selection of tractor tyres	1
6	Problem on design of governor and problem related to selection of hydraulic pump	2
7	Engine testing as per BIS code- various tests	1
8	Drawbar performance in the lab.	1
9	PTO test and measure the tractor power in the lab. / field	1
10	Determining the turning space, turning radius and brake test	1
11	Hydraulic pump performance test and air cleaners and noise measurement test	2
12	Visits to tractor testing centre / industry	1
	Total	**16**

Reference Books

- Tractors & their power units, By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki
- Tractor, By: Oleg Sapunon
- Theory of machines , By: P.L. Ballaney
  Theory of machines v R.S. Khurmi

Sr. No.	Course Name	Course No.	Credit	L	P	T
14	**Hydraulic Drive & Controls**	**FMP – 403**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

Hydraulic basics, Pascal's law, Flow, Energy, Work and Power. Hydraulic Systems, Color coding, reservoirs, Strainers and filters, Filtering materials and elements, Accumulators, Pressure gauges and Volume meters, Hydraulic circuits, Fittings and Connectors. Pumps, Pump classifications, Performances, Displacement, Designs, gear Pumps, vane pumps, Piston pumps, Pump operation. Hydraulic Actuators, Cylinders, Construction and Applicators, Maintenance, Hydraulic motors, Valves, Pressure control valves, Directional control valves, Flow control valves, Valve installation, Valve failures and remedies, Valve assembly, Trouble shooting, Valve Hydraulic circuit diagrams and troubleshooting, United states of American standard Institute, USASI Graphical symbols, Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems, Robotics, Use of Hydraulic and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls)

Planning of lectures

Sr. No.	Topics to be covered in Lecture	No. of Lectures
1	Hydraulic basics	2
2	Pascal's law, Flow, Energy, Work and Power	3
3	Hydraulic Systems	2
4	Color coding, reservoirs, Strainers and filters	3
5	Filtering materials and elements	2
6	Accumulators, Pressure gauges and Volume meters	3
7	Hydraulic circuits, Fittings and Connectors	2
8	Pumps, Pump classifications, Performances, Displacement	3
9	Designs, gear Pumps, vane pumps, Piston pumps, Pump operation	3
10	Hydraulic Actuators, Cylinders, Construction and Applicators, Maintenance	2
11	Hydraulic motors, Valves, Pressure control valves, Directional control valves, Flow control valves, Valve installation, Valve failures and remedies, Valve assembly, Trouble shooting	2
12	Hydraulic circuit diagrams and troubleshooting, United states of American standard Institute, USASI Graphical symbols	2
13	Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units	2
14	Fail safe and safety systems, Robotics, Use of Hydraulic and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls)	2
	Total	**33**

Practicals		
Sr. No.	Topic	No. of practicals
1	Introduction to Hydraulic systems	1
2	Study of hydraulic pumps	2
3	Study of hydraulic actuators	2
4	Study of hydraulic motors	1
5	Study of hydraulic valves, hydraulic codes and circuits	3
6	Building simple hydraulic circuits, hydraulics in tractors	3
7	Introduction to pneumatics, pneumatics devices	1
8	Pneumatics in Agriculture	1
9	Use of hydraulic and pneumatics for Robotics	1
	Total	**15**

Reference Books

- Hydraulic control systems , By: Merritt H.E., John Willey & Sons, New York
- Design of Agricultual Machines , By: Krutz G., John Willey & Sons, New York
- Fluid mechanics and hydraulics with computer application, By: Dr. Jagdish Lal
- A text book . of Hydraulic fluid mechancis and hydraulic machines, By: R.S. Khurmi
- Hydraulic and fluid mechanics , By: P.N. Modi and S. M. Sheth
- Engineering Fluid mechanics , By: K.L. Kumar
- Tractors & their power units , By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki

Sr. No.	Course Name	Course No.	Credit	L	P	T
15	**Farm Power and Machinery Management**	**FMP - 405**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

The role of mechanization and its relationship to productivity, employment, social and technological change; performance and power analysis; cost analysis of machinery: fixed cost and variable costs, effect of inflation on cost; selection of optimum machinery and replacement criteria; Break-even analysis, reliability and cash flow problems; mechanization planning; case studies of agricultural mechanization in India.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Role of mechanization and its relationships to productivity, employment, social and technical changes	6
2	Performance and power analysis	3
3	Cost analysis of machinery- fixed cost and variable costs, effects of inflation on cost	5
4	Selection of optimum machinery and replacement criteria	5
5	Break even point and its analysis, reliability and cash flow problems	5
6	Mechanization planning	4
7	Case studies and agricultural mechanization in India	4
	Total	**32**

Practicals		
S.No.	Topic	No. of Practicals
1	Mechanization and role in different capacities	2
2	Solving problems related to cost analysis and inflation	2
3	Solving problems related to selection of equipment / machinery	1
4	Solving problems related to replacement of machinery / equipment	1
5	Break even point and its analysis	1
6	Role of time value of money	1
7	Seminar on the topic on farm machinery management	2
8	Design of farm mechanization plan for different farm size and cropping pattern	2
	Total	**12**

Reference Books

- Farm machinery & management , By: Hunt D.
- Principle of Agril. Engg. Vol I, By: Michel A.M. & T.P. Ojha
- Principles of farm machinery , By: R.A. Kepner, Roy Bainer, E.L. berger
- Agril. Engg. (through worked examples) , By: R. Lal & A.C. Datta
- Farm machinery operation and care , By: J.C. Turner
- Farm mechanization; costs & methods , By: Cuplin C. and Claude S.

Sr. No.	Course Name	Course No.	Credit	L	P	T
16	**Human Engineering and Safety**	**FMP - 407**	**2 (1 + 1)**	**1**	**1**	**0**

Course content:

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Human factors in system development – concepts of system	1
2	Basic process in system development, performance reliability, human performance	2
3	Information input process, visual display, major types and use of displays, auditory and factual display	2
4	Speech communications	1
5	Biomechanics of motion, types of movements, range of movements	1

6	Strength and endurance, speed and accuracy, human control of systems	1
7	Human motor activities, controls, tools and related devices	1
8	Anthropometry	1
9	Arrangement and utilization of work space, atmospheric condition , heat exchange process and performance, air pollution	2
10	Dangerous machine (Regulation) act	1
11	Rehabilitation and compensation to accident victims	1
12	Safety gadgets for spraying, threshing, chaff cutting	1
13	Safety gadgets for tractor and trailer operation etc.	1
	Total	**16**

Practicals

S.No.	Topic	No. of Practicals
1	Use of bicycle ergo meter for calibration of subject in laboratory	1
2	Calibration of subject in the lab. using tread mill	1
3	Study of respiration gas meter and its use in farm operations	2
4	Calibration of subject using heart rate monitor	2
5	Study of general fatigue of the subject using Blink ratio method	1
6	Study on the use of electromyography equipment	1
7	Anthropometric measurements of farm workers and statistical analysis	2
8	Strength parameter measurements of farm workers and statistical analysis	1
9	Study of optimum work place layout and locations of controls	2
10	Familiarization of noise and vibration equipment	2
	Total	**15**

Reference Books

- Human factors in Engg. & design – Sanders M.S. and McCormick E.J.
- Fitting the task to the man, A text of occupational ergonomics – Grandjean E.
- Related journals
- AICRP reports of Ergonomics & safety in Agriculture

Sr. No.	Course Name	Course No.	Credit	L	P	T
17	**Production Technology for Agril. Machinery**	**FMP - 409**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Critical appraisal in production of Agricultural Machinery; Modeling and stress analysis of Machinery parts by using standard software; 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), 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, Quality management,. Economics of process selection. Techno-economic feasibility of Project Report. Selection of Standard/ critical components. Case studies of manufacturing of agril. machinery. Servo motors, drives & controllers, CNC controllers for machine tools. CNC programming. Assembly and plant automation. Storage and transportation.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Critical appraisal in production of agricultural machinery, modeling and stress analysis of machinery part by using standard software	2
2	Advance in material used for tractor and agril. Machinery cutting tools including CNC tools and finishing tools	3
3	Advance manufacturing techniques like EDM, Pm	2
4	Heat treatment of steel including pack carburizing shot pining, chemical vapour deposition	4
5	Limits, fits, tolerance, jig & fixture, micro structure analysis, industrial lay out planning, quality management	4
6	Economics of process selection	2
7	Techno economic feasibility of project report, selection of standard / critical components	4
8	Servo motors, drive and controllers	2
9	CNC controllers for machine tools	3
10	CNC programming	3
11	Assembly and plant automation storage and transformation	3
	Total	**32**
Practicals		
S.No.	Topic	No. of Practicals
1	Study of use of standard software in production of agriculture machine and machine components	1
2	Study of CNC machine and working principle of CNC machine	1
3	CNC programmes for manufacturing of agriculture machine components	2
4	Study of EDM machine	1
5	To increase the hardness of agriculture machine components by hardening and carburizing process	2
6	Study of shot ring operation and shot machinery	1
7	Design and drawing of cultivator / seed drill parts	2
8	Design and drawing of sprayer parts	2
9	Design and drawing of harvester and thresher parts	1
10	Study of plant lay out and problem on lay out planning of small scale industry	2
11	Case study for manufacturing of tractor through industry visit	1
	Total	**16**

Reference Books

- Workshop Technology Vol. I & II , By: S.K. Hajra Chaudhary
- Mechatronics , By: K. Adinarayana
- Design of Machine Tools , By: S.K. Basu & D.K. Pal
- Manufacturing Science and Technology , By: S. Dalela
- Production Technology, By: Sharma P.C.
- Workshop Technology , By: R.S. Khurmi & Gupta
- Quality in Design and Manufacturing (CAD/CAM) , By: Dalela Suresh

Sr. No.	Course Name	Course No.	Credit	L	P	T
18	**Mechanics of Tillage and Traction**	**FMP - 411**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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 performance of tillage tools. 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, soil compaction and plant growth, variability and geo statistic, application of GIS in soil dynamics.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to mechanics of tillage tools	2
2	Engineering properties of soil, principles and concepts, stress strain relationship	4
3	Design of tillage tools , principles of soil cutting	3
4	Design equation, force analysis	3
5	Application of dimensional analysis in soil dynamics performance of tillage tools	4
6	Introduction to traction and mechanics, off road traction and mobility	4
7	Traction model, traction improvement, traction prediction, tyre size, tyre lug geometry and their effects, tyre testing	4
8	Soil compaction and plant growth, variability and geo statistic , application of GIS in soil dynamics	4
9	General revision and doubts	4
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Measurements of static soil parameters related to tillage	1
2	Measurement of dynamic soil related to tillage	1
3	Measurement of soil parameters related to puddling and floatation	2
4	Measurement of draft for passive rotary and oscillating tools	2
5	Measurement of slip and sinkage under dry and wet soil conditions	2
6	Measurement of load and fuel consumption for different farm operations	3

7	Economics of weight transfer and tractor loading including placement and traction aids	2
8	Studies on tyres, tracks and treads under different conditions	2
9	Studies on compaction and number of operations	1
	Total	**16**

Reference Books

- Agricultural machines, By : N.I. Klenin, I.F. Popov & V.A. Sakum
- Tractors & their power units , By : J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki
- Tractor implement systems, By : Ralph Alcocl
- Farm machinery , By : S.C. Jain
- Design of Agril. Machinery , By : Garry Krutz
- Principles of Farm machinery , By : R.A. Kepner, Roy Bainer & E.L. Barger

Sr. No.	Course Name	Course No.	Credit	L	P	T
19	**Environmental Engineering**	**RE - 405**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Importance of safe water supply system. Domestic water requirements for urban and rural areas. Sources of Water supply. 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. 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. Introduction to air pollution. Types of pollutants properties and their effects on living beings. ISI standards for pollutants in air and their abetments.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Importance of safe water supply system,	2
2	Domestic water requirements for urban and rural areas. Sources of Water supply Intakes and transportation of water	4
3	Drinking water quality. Indian Standards of drinking water.	3
4	Introduction to water treatment Domestic waste water: quantity, characteristics, disposal in urban and rural areas.	4
5	Sewer: types, design discharge and hydraulic design.	4
6	Introduction to domestic wastewater treatment. Design of septic tank.	4
7	Solid waste: quantity, characteristics and disposal for urban and rural areas.	4
8	Introduction to air pollution. Types of pollutants properties and their effects on living beings.	4
9	ISI standards for pollutants in air and their abetments.	3
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Determination of turbidity; pH of solution;	2
2	Suspended solids; Dissolved solids; Total solids;	2

3	Temporary hardness; Permanent hardness;	2
4	Fluorides; Chlorides,	1
5	Dissolved oxygen; BOD	2
6	Collection of air samples and their analysis;	2
7	Numerical problems related to theory	3
8	Visit to treatment plant.	2
	Total	**16**

Reference Books

- Wastewater treatment for Pollution control, By: Soli J. Arceivala
- Wastewater Engineering Treatment Disposal, By: Metcalf & Eddy
- Environmental Engineering (Vol.I) , By: S.K.Garg
- Environmental Engineering (Vol.II) , By: S.K.Garg
- Elements of Environmental Engineering, By: K.N.Duggal, S.
- Manual on Water Supply and treatment, Central Public Health & Environmental Engineering Organisation, New Delhi
- Standard Methods for the Examination of Water & Wastewater, American Public Health Association
- Manual on sewerage and sewage treatment, Ministry of Urban Development, New Delhi
- Fundamentals of Air Pollution, By: B. S. N Raju,

Sr. No.	Course Name	Course No.	Credit	L	P	T
20	**Biomass Management for Fodder and Energy**	**RE - 407**	**2 (1 + 1)**	**1**	**1**	**0**

Course content :

Introduction to biomass management, biomass resource assessment management techniques/supply chains, Processing of paddy straw, densification- Extrusion process, pellets, mills and cubers, Bailing-classification, uses; residue management for surface mulch and soil incorporation, Paddy Straw choppers and spreaders as an attachment to combine Harvester, Mulch seeder, Paddy Straw Chopper-cum-Loader, Balar for collection of straw; 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to biomass management, biomass resource assessment management techniques/supply chains,	2
2	Processing of paddy straw, densification- Extrusion process, pellets, mills and cubers,	2
3	Bailing-classification, uses; residue management for surface mulch and soil incorporation,	2
4	Paddy Straw choppers and spreaders as an attachment to combine Harvester,	2
5	Mulch seeder, Paddy Straw Chopper-cum-Loader, Balar for collection of straw	2
6	Processing of straw/ fodder for animal use; Agricultural and horticultural use, Cushioning material for fruits and vegetables	3

7	Mulching and Composting, Paper and cardboard manufacturing, Straw as a fuel.	3
	Total	**16**
	Practicals	
S.No.	Topic	No. of Practicals
1	Familiarization with different straw management techniques	2
2	On-farm and off-farm uses of straw	1
3	Collection, loading and transport equipments for unbruised loose straw	2
4	Briquetting machine and preparation of briquettes	2
5	Straw baler and making of bales in the field	2
6	Straw/ fodder chopping machines	2
7	Straw/ mulching & incorporating machinery	2
8	Machinery requirement for baling forage crops for silage	2
	Total	**15**

Reference Books

- Principles of Farm Machinery, 3rd Edition, By: R.A. Kepner, Roy Bainer & E.L. Barger,
- Biomass Management Systems , By: Braden Allenby,
- Biomass Resource Assessment California Biomass Collaborative Biological & Agricultural Engineering University of California, 1 Shields Avenue, Davis, CA 95616-5924

Semester -VIII

S.No.	Course Name	Course No.	Credit
1.	Educational tour.	AE - 402	05
2.	In-Plant Training Student will undertake in-plant training ,which includes practical training at the Institution, one training of 4 months or two trainings of 2 months each in. Industrial Units/Hands on Training Units in any discipline of Agril. Engg.	AE - 404	20
		Total	**25**

Educational tour: Study tour of 15 days and submission of report of it is compulsory for all students. The study tour for the final year students will be organized by the college as per prevailing rules of the University.

In-Plant Training (25 credit hours): The in-plant training is intended to expose the students to an environment in which they are expected to be associated in their future career. The students will be required to have hands-on-experience at progressive farms, research institutions manufacturing or agro-processing industries and in rural areas. The training includes farm planning and development of irrigation/drainage project, watershed development, manufacturing technology of agricultural or processing machinery, testing and evaluation, quality control, marketing and servicing.

Objectives: Hands-on-training in:

- Manufacturing testing and evaluation, sales and marketing and service
- Farm development, irrigation and drainage project planning, watershed development
- Agro-processing, food product development and manufacture

Operational Aspects

- The training shall be compulsory and form a part of the curriculum for the award of the degree
- This programme be conducted in the final year of the degree programme
- Six months duration shall be covered during the final year for the training to be carried out at various centers, plants and institutes
- The detailed programme of work shall be developed and carried out by the students. The evaluation procedures to be followed shall be prepared by the concerned faculty/department of the institute in the form of a manual for reference of students,

evaluators and the functionaries concerned. The manual shall contain all details about training programme.

- The credit for training programme shall be 25.
- The programme shall be of residential nature and it shall be compulsory for the student to stay at the place of posting.
- A minimum of 80 percent attendance is necessary during the training programme
- Supervision: In order to take policy decision and to solve the operational and administrative bottleneck if any, there should be a college level committee consisting of the following:

Dean, College of Agricultural Engineering	- Chairman
Chairman Academic Committee of college	- Member
Head of concerned department	- Member

Experiential Learning: The experiential learning is intended to build practical skills and entrepreneurship among the graduates with an aim to deal with work situations and for better employability and self-employment. It will involve setting-up of model plans for food processing and value addition for product diversification, setting up of workshops for manufacturing, operation and maintenance of farm machinery and equipment, maintenance and custom hiring of farm machinery and equipment. Thus, besides in-plant training, two hands-on training programme, each of six weeks duration during summer breaks of second
year and third year would be required to be completed by every student. Performance of the students in the training programme be evaluated based on: (a) work quality, (b) acquired knowledge and expertise, (c) attendance, (d) maintenance of records (e) report, (f) demonstration and presentation in seminar, and (g) work outcome.

The suggested areas for experiential learning are as follows:

1. Fabrication of marketable tools and implements Facility required - Production workshop
2. Processing of agri-produce Facility required - Agro-processing centre - Pilot plant for processing and packaging of selected grain/horticultural crop
3. Custom hiring of package of farm equipment Facility required - Tractor and set of farm implements.