VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Agricultural Engineering

Scheme of Teaching and Examinations 2021

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year2021-22)

Swappable VII and VIII SEMESTER

VIISEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department(TD) and Question	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical	Self-Study	Durationin	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21AG71	Post-Harvest Processing of Horticultural Crops	TD,PSB-AG	3	0	0		3	50	50	100	3
2	PCC 21AG72	Irrigation and Drainage Engineering	TD,PSB-AG	3	0	0		3	50	50	100	2
3	PEC **21AG73X**	Professional elective Course-II	TD,PSB-AG	3	0	0		3	50	50	100	3
4	PEC **21AG74X**	Professional elective Course-III	TD,PSB-AG	3	0	0		3	50	50	100	3
5	OEC **21AG75X**	Open elective Course-II	TD,PSB-AG	3	0	0		3	50	50	100	3
6	Project **21AGP76**	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
							Total		**350**	**350**	**700**	**24**

VIIISEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory	Tutorial	Practical	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21AG81		Technical Seminar		One contact hour /week for interaction between the faculty And students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education(PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective-II			
21AG731	Remote Sensing and GIS Applications	21AG734	Food Plant Design and Management
21AG732	Bio-energy Systems: Design and Applications	21AG735	Mechanics of Materials
21AG733	Precision Agriculture and System Management		

Professional Elective-III			
21AG741	Mechanics of Tillage and Traction	21AG744	Design of Agricultural Machinery
21AG742	Plastic Applications in Agriculture	21AG745	Process Equipment Design
21AG743	Food Quality and Control		

Open Electives-II offered by the Department to other Department students			
21AG751	Solid Waste & By-Product Utilization		
21AG752	Water Harvesting and Soil Conservation Structures		
21AG753	Micro irrigation Engineering		

Post-Harvest Processing of Horticultural Crops (PCC)			
Course Code	**21AG71**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To enable the students to understand Concept of Structure and Composition of Fruits, Vegetables and Flowers.
- Physiology and Biochemistry of Horticultural Produce, Maturity indices in horticultural produce.
- Methods for determination of harvesting indices, wet and dry brushing, chemical washing, Chemical preservation with sulphur dioxide and benzoic acid, advantages, disadvantages, Chemical preservation with sulphur dioxide, Quality and grades specification of horticultural produce.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Importance of Post Harvest Technology in in Horticultural Crops. Structure and Composition of Fruits, Vegetables and Flowers. Physiology and Biochemistry of Horticultural Produce. Causes of Postharvest losses. Factors affecting fruits and vegetables quality: Pre-harvest factors, environmental factors, cultural factors and post-harvest factors. Maturity indices in horticultural produce. Methods for determination of harvesting indices. Handling and transportation of fruits and vegetables. Determination of quality parameters for fruits and vegetables: aroma, fruit ripening, leaf changes, firmness, juice content, sugar content, skin color, total soluble solids, pH and acidity

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

Post-Harvest Operations: Pre-cooling, Cleaning of fruits & vegetables: soaking, rinsing, sanitizing, washing methods: agitating, spraying water, wet and dry brushing, chemical washing. Peeling of fruits and vegetables: hand peeling, mechanical peeling, peeling by heat treatment and lye peeling. Grading of fruits & vegetables, factors affecting grading, types of graders: screen grader, roller grader, rope and cable type grader and weight grader. Canning of fruits and vegetables: grading, washing, peeling, cutting, blanching, cooling, filling, syruping/brining, exhausting, sealing, retorting, cooling, storage, labeling. Cans	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Principles of Preservation of Fruits & Vegetables: Asepsis, preservation by high temperature: pasteurization, flash pasteurization, sterilization. Chemical preservation with sulphur dioxide and benzoic acid, advantages, disadvantages. Sprout Suppressants. Fruit coating-Waxing. Drying and dehydration of fruits & vegetables (flow chart), types of dryers: cabinet dryer, tray dryers, tunnel dryer, freeze drying. Rehydration, ratio of rehydration coefficient. Freezing: Definition and methods - slow freezing, quick freezing and IQF, advantages and disadvantages. Types of freezing - direct immersion, indirect contact with refrigerant, air blast, cryogenic and de-hydro freezing. Cooling methods - pre-cooling, room cooling, hydro cooling, refrigerated trucks.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Storage of Horticultural crops: Traditional storage, Improved storage methods, Controlled atmospheric storage (CAS), factors effecting on CAS, modified atmosphere storage/packaging (MAS/MAP), maintenance of MAP, active modification, passive modification, requirements of fresh fruits package under CAS or MAS. Packaging of fruits and vegetables, advantages and disadvantages. Packaging materials: Corrugated fibre-board boxes, cellophane, poly vinyl chloride, polyethylene, ethyl vinyl alcohol.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	
Post-harvest disorders in horticultural produce: Causes of physiological disorders, Mineral deficiency disorders, Low-temperature disorders, Important physiological disorders of vegetable crops. Quality and grades specification of horticultural produce. Regulation of ripening	
Teaching-	1. PowerPoint Presentation

Learning Process	2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Explain about the properties and factors affecting quality of fruits and vegetables.
- Classify post-harvest operations involved in horticulture processing.
- Identify preservation techniques for processed foods.
- Apply the advanced packaging technology in food preservation.
- CO5: Identify post-harvest disorders in horticultural produce.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Fruits and Vegetable Preservation: Principles and Practices, Srivastava, R.P. & Kumar, S. CBS Publishing, 3rd edition, 2014.
2. Food Science by Potter N. and Hotchkiss J. H, An Aspen Publication, 5th edition, 2007.
3. The Complete Technology Book on Processing, Dehydration, Canning, Preservation of Fruits & Vegetables by NIIR Project Consultancy Services, 3rd edition, 2016.
4. Fruits: Tropical and subtropical, Bose T. K & Mitre, S. K. Naya Prakash, 3rd edition, 2001.
5. Fruits and Vegetable processing, Bhatti, S. and Varma U., 1st edition, CBS Publishers, 2007.
6. Food Processing and Preservation, Sivasenkar, B., CBS Publications, 2002.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

IRRIGATION AND DRAINAGE ENGINEERING			
Course Code	**21AG72**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	02	Exam Hours	03

Course Objectives:

- To illustrate the knowledge of irrigation concept, terminology and its effecting factors
- To make the students use the knowledge of different irrigation systems and its efficiencies for optimization of irrigation water at filed level.
- To enlighten the students with appropriate design techniques of drainage systems for effective land and water management.
- To impart the knowledge on importance of drainage and the design of different drainage structures and their mechanisms.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.

2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Irrigation: Introduction to Irrigation Engineering, advantages of irrigation, necessity and development of irrigation in India and AP. Classification of irrigation projects. Irrigation terminology- GCA, CCA, Base period, crop period, Delta, Duty, Relationship between Duty and Delta (Delta= (864B) / Duty cm).

Soil- Plant- Water Relationships: Introduction soil-water plant relationships, soil physical properties such as soil texture, soil structure, capillary conductivity, soil consistency – mass – volume relationships of soil constituents. Water relations of soil, kinds of soil water-Hygroscopic, Capillary and Gravitational movement of water into soils, Infiltration, factors affecting infiltration. Soil moisture characteristic curves, difference between soil moisture stress and soil moisture tension, soil moisture constants such as saturation capacity, field capacity moisture equivalent and permanent wilting point. Measurement of soil moisture by different methods, Evaporation, transpiration and evapotranspiration-Estimation by Blaney-Criddle, Thornthwaite, penman and modified Penman equations only-Potential ET.

Crop Water Requirement and Irrigation Management: Water requirements of crops-Importance of water in plant growth, procedures of working out the net irrigation requirement (depth of irrigation) gross irrigation requirement, irrigation frequency and Irrigation efficiency (conveyance, application, storage, distribution, water use efficiency) with few numerical examples.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

Application of Irrigation Water: Water application methods and their classifications –border irrigation, components of border irrigation–Width, Length and Slope for different soils. Hydraulics of border irrigation (Advance curve, Recession curve, Opportunity time through Time and Distance Curve), design of border irrigation. Derivation of Israelson's equation for the width of the border (X= (Q/W.I) (1-e -It/y). Furrow irrigation system–advantages and disadvantages, determination of infiltration depth in furrows by inflow–outflow method (Steam size, Distance Advance time, CS area and Wetted Perimeter data problem on computation of infiltration depth). Check basin irrigation– advantages and disadvantages, estimation of infiltration under check basin conditions, adaptability and design considerations.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-3

Conveyance of Irrigation Water: Methods of conveyance of irrigation water–assessment of design capacity of irrigation channels. Design of irrigation canals using Lacey's and Kennedy's theories and problems. Measurement of irrigation water-units of measurements, methods of measurement, direct and indirect methods. Underground Pipe Line Systems: Underground pipe lines for irrigation water distribution–types of pipes used for underground pipe lines, testing of pipes for its water absorption and pressure requirements, estimating the discharge capacity of

pipe lines, Installation procedures of underground pipe lines.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-4

Drainage of Agricultural Lands: Drainage–definition, objectives and types, familiarization with the drainage problems (twin problems of water logging and salinity) and extent of areas in irrigated areas in the state, Surface drainage, effects of poor drainage, areas requiring drainage, factors affecting drainage requirement, drainage coefficient, determination of drainage coefficient based on different criteria. Types of surface drainage-random field drain system, bedding system, parallel field drain, parallel lateral open ditch, cross slope drain system interception system, design of open drainage channels using Manning's equation and alignment of open ditches (radius of curvature), methods of determining hydraulic conductivity–single auger hole method and derivation of Hooghoudt's equation for 'K' with assumptions and inverse auger hole.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-5

Sub-Surface Drainage Systems: Sub-surface drainage systems purpose and benefits, types of sub surface systems tile drains, mole drains, drainage wells, deep open drains and combinations and their suitability for different conditions and limitations. Components of Sub–surface drainage system Layouts and types – Random type herring bone, grid iron cutoff or interceptor drains, depth and spacing of drains, size of the pipe drains using Manning's equation, drain materials of burnt clay. Design of subsurface drains under steady state (equilibrium) conditions, derivation of Hooghoudt's equation for spacing, The Ernst's derivation for drain spacing, Glover- Dumm equation (only) for spacing under non-steady state conditions of water table to drop from 'm0' to 'm' in time 't', Drainage structures, Loads on conduits, ditch conduit conditions and projecting conduit conditions, construction and installation of drains, Bio-drainage, vertical drainage and drainage of irrigated and humid areas, Salt Problems in Soil and Water: Salt balance, classification and reclamation of saline and alkaline soils, soil amendments, leaching requirement-leaching ratio.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply irrigation terminology, soil moisture characteristic curves and evapotranspiration methods to quantify crop water requirement.
2. Choose appropriate irrigation methods, advantages, disadvantages, hydraulics design and components

3. Estimate irrigation canals capacity by lacey's and kennedy's methods.
4. Identify types, functions, components and factors affecting on surface and subsurface drainage systems.
5. Determine drain spacing under unsteady and steady state conditions by Hooghoudt's and Glover dumm equations.

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

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2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Irrigation Engineering, Mazumdar S K, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Irrigation Theory and Practice, Michael A M, Vikas Publishing House, New Delhi.
3. Land and Water Management Engineering, Murthy VVN and Madan K Jha,Kalyani Publishers, New Delhi.
4. Soil and Water Conservation Engineering, Schwab G O, Frevert R K, Edminister T W and Barner K K, Jhon-Wiley and Sons, New Delhi.
5. Drainage Engineering, Luthin J M, Wiley Esatern Ltd., New Delhi.

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/105104103/
2. http://ecoursesonline.iasri.res.in/course/view.php?id=2
3. https://freevideolectures.com/course/95/soil-mechanics
4. https://www.btechguru.com/GATE--civil-engineering--soil-mechanics-video-lecture-- 34.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Remote sensing and GIS applications (PE-II)			
Course Code	**21AG731**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To equip the students with the knowledge on techniques of Remote Sensing and GIS applications for land and water resources management.
- To impart the knowledge on advance techniques such as hyper spectral, thermal and LiDAR units scanning for mapping, modelling and monitoring.
- To enable the students to use GIS software to perform different spatial and satellite image analysis.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Remote sensing: Introduction to Remote Sensing, stages of remote sensing, Data acquisition and analysis, Sensors- Remote sensing types and applications, important features of Indian Remote Sensing Satellites, Electromagnetic spectrum: Different bands, Resolution, Spectral response Pattern-multi spectral data use, modern remote sensing technology versus conventional aerial photography	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-2	
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, pixel, resolution, Image processing overview; Image restoration- Radiometric correction-DN (Digital Number value) – Noise removal and correction, Atmospheric error and correction, Geometric Error and correction;	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Image enhancement -Contrast manipulation-gray level thresholding-level slicing-contrast stretching, Digital image processing-spatial Feature Manipulation-spatial filtering convolution edge enhancement. Vegetation Indices: Digital image processing, vegetation components, supervised and unsupervised image classification and output stage data merging,	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Remote sensing in agriculture: Progress and prospects of yield assessment, remote sensing application in water resources development, remote sensing in soil conservation, aerial photo interpretation for water resources development and soil conservation survey. Remote sensing in geology and soil mapping.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	

Geographical Information System: History of development of GIS: Definition, Basic components and standard GIS packages. Date entry, storage and maintenance, Data types – spatial, non-spatial (attribute-date), 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	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Explain Remote Sensing and GIS concepts and components.
2. Assess spectral data and sensors potential for spatial analysis
3. Apply image interpretation technique to interpret and DIP technique to correct remotely sensed image.
4. Apply image enhancement techniques to enhance and improve remotely sensed image.
5. Apply remote sensing image interpretation technique for the advanced uses of agriculture.
6. Use different GIS soft wares and knowledge of GIS to do spatial data analysis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Remote sensing and Geographical information system, B.S. publications.
2. Introduction to remote sensing, James B and Compell, Published by Taylor & Francis Limited.
3. Remote Sensing and Image Interpretation, Lillesand, Kiefer and Chipman Published by Wiley.
4. Basics of remote Sensing and GIS, University Science Persons.
5. Remote Sensing and GIS by Basudeb Bhatta, Oxford University Persons, NewDelhi.
6. Fundamentals of Remote Sensing, George Joseph and C. Jeganathan, Universities Press Publisher.
7. Remote Sensing And Geographic Information System Paper, Chandra, Narosa Publisher.

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/downloads/105108077/
2. http://civil.iisc.ernet.in/~nagesh/rs_gis.htm
3. http://geology.wlu.edu/harbor/geol260/lecture_notes/notes.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Bio-energy Systems: Design and Applications (PE-II)			
Course Code	**21AG732**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To provide in depth knowledge on basic principles of Bio-energy systems
- To provide skills in design and operation of major bio-energy systems like, improved biomass stoves, biomass furnaces, biogas plants, biomass gasifiers etc. and related appliances

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Fermentation processes and its general requirements: an overview of aerobic and anaerobic fermentation processes and their industrial application. Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-2	
Biomass Production: Wastelands, classification and their use through energy plantation, selection of species, methods of field preparation and transplanting. Harvesting of biomass and coppicing characteristics	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Biomass preparation techniques for harnessing (size reduction, densification and drying). Thermochemical degradation. History of small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics. Transesterification for biodiesel production.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	
A range of bio-hydrogen production routes. The environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO 1: Apply their knowledge and Understand methods of Cultivation of bio-mass
CO2: Analyze the problems and principle of different types of biomass gasifier
CO3: Apply and develop new type of models of gasifiers
CO4: Apply their knowledge in biodiesel production
CO5 : Analyze the production of hydrogen energy

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. British BioGen. 1997, Anaerobic digestion of farm and food processing practices- Good practice guidelines, London, available on www.britishbiogen.co.UK.

2. Butler, S. 2005. Renewable Energy Academy: Training wood energy professionals.
3. Centre for biomass energy. 1998. Straw for energy production; TechnologyEnvironment-Ecology.
4. Mathur, A.N. and Rathore N.S. 1992. Biogas production, management and utilization. Himanshu Publication. Delhi.
3. Mital, K.M., 1996, Biogas systems; Principles and applications, New Age International (P) ltd. Publishers, New Delhi.
4. Rai G.D. 1989. Non-conventional Sources of energy. Khanna Publishers. Delhi.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Precision Agriculture and system Management (PE-II)			
Course Code	**21AG733**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- Precision agriculture aims to achieve maximum crop productivity using information and technology (IT) based farming.
- The spatio-temporal variability at farm level is optimized with the use of IT based farming resources in order to facilitate productivity of land resources with minimized production costs
-

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.

4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Definition, need and its functional requirements, history of green revolution, issues related to natural resources, farm level constraints for crop production, field level spatio-temporal variability in crop productivity, sources of variability and its influence on morphology, analysis of variability, crop land and productivity in India Familiarization with precision agriculture problems and issues, calculation of variability of resource map e.g., soil, land resources in terms of percentage, acreage and corresponding descriptive statistics.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

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. Global Positioning System (GPS), differential GPS, grid sampling, remote sensors - aerial and satellite sensors, proximate sensors–drones, overview of indirect measurement of plant-soil health using spectral reflectance, replacing soil testing with sensor based technology.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-3

Introduction to GIS, create maps and tables of properties associated with layer, create new layers using geospatial analysis of land and water resource layers, summarization of results as tables, maps and graphs, creation of geo database Using QGIS GIS software to add layers of soil and water resources, sensor data for a field level analysis of agricultural production and create a table and graph of yield data

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-4

System concept in precision agriculture, need of a system concept, precision farming system strategy, capacity of system, system approach in farm machinery management, problems on machinery selection, maintenance, monitoring and scheduling of operations. Problems on system limitation, pattern efficiency, system capacity

Teaching-	1. PowerPoint Presentation

Learning Process	2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-5

Planning and scheduling of precision agriculture, techniques and tools used for project planning – critical activities, minimum project time, Critical Path Method(CPM), Cost-time-trade-off, Project Evaluation and Review Technique (PERT), machinery system management using PERT and CPM, cost analysis and inflation, selection of equipment, replacement , break-even analysis and time value of money.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Understand the issues and importance of precision agriculture

CO2: Explain tools and equipment used in precision agriculture

CO3: Apply the knowledge of GIS technology in precision agricultural operation and management

CO4: Explain the importance of system concept in precision agriculture

CO4: Apply the learnt knowledge to maximize crop productivity using precision farming

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

2. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Kent Shannon, D., Clay, D.E., and Kitchen, Newell, R., 2020. Precisionagriculture basics, Wiley, USA
2. Zhang, Q., 2015. Precision agriculture technology for crop farming. CPCPress, Taylor Francis Group, USA
3. Snapp, S., and Pound, B., 2017. Agricultural systems, Agroecology andrural innovation for development. 2 nd edition, Academic Press, Elsevier, UK.
4. James P. Lewis, 2004. Project planning, scheduling and control. 3 rd edition, TataMcGraw-Hill Publishing Company limited, New Delhi.

Web links and Video Lectures (e-Resources):

1. Pivoto, D., et al., 2017. Scientific development of smart farming technologies and their application in Brazil. Information Processing in Agriculture,

2. FAO, 2017. http://www.fao.org/e-agriculture/news/precision-agriculture- smart-farming-approach-agriculture

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Food Plant Design and Management (PE-II)			
Course Code	**21AG734**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- Students will be trained in organization of food and agricultural processing plant machinery as per process flow, site selection, layout procedures, project design concepts, etc. will be explained for bringing the talent to establish an engineering industry.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Plant layout – Definition, and principles, factors in planning layouts. Methods of layout planning – Unit areas concept, two – dimensional layouts, scale models. Principles of plant layout – Storage layout, equipment layout, safety, plant expansion, floor space, utilities servicing, building, materials handling

equipment, rail road's and roads.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-2	
Types of plant layout – salient features of horticultural, rice, maize, pulses, oil seeds, poultry, fish, meat, milk and milk product plants.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Location selection criteria – Plant location, factors in selecting a plant, selection of the plant site, preparation of the layout. Selection of processes – Comparison of different processes, batch versus continuous operation. Plant capacity – Equipment design and specifications, scale – up in design, safety factors, specifications, materials of construction. Project design – Process design development, general overall design considerations, cost estimation, factors affecting profitability of investments, optimum design (economic and operation). Project design – Practical considerations in design, approach. Project design – Types of designs, feasibility survey, process development, design, construction and operation	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Flow diagrams-qualitative and quantitative flow diagrams. Selection of equipment – Preliminary design, problem statement, literature survey, material and energy balance, equipment design and selection, problems, economics. Process and controls-Control systems, instrumentation control, maintenance, computer aided design. Handling equipment - Selection, factors, pumps, piping, fittings, solid feeders, plant layout. Plant elevation - Requirement of plant building and its components, foundation for equipment and dynamic loading, flooring, walls, roof, illumination, air-conditioning. Labor requirement for processing plant - Labor costs, maintenance.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	

Food plant sanitation-Environmental protection, regulations, pollution control, air pollution abatement, particulate removal, noxious gas removal, thermal pollution control, recycling, CIP. Cost analysis cost indexes - Cash flow for industrial operations, factors affecting investment and production costs, capital investment, and estimation of capital investment. Cost analysis – Cost indexes, cost factors in capital investment, estimation of total product cost. Preparation of feasibility report -Types of repots, organization of reports, organization of a design report, preparing the report, rhetoric, checklist for the final report	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Course outcome (Course Skill Set) At the end of the course the student will be able to : CO1: Explain the principles of plant layout CO2: Select a suitable plant layout for a given product CO3: Use principal considerations for plant location and design of layout CO4: Describe the design criteria of plant building CO5: Estimate Cost indices, total product cost	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Dairy and Food Engineering, Farall F W 1992. John Wiley & Sons, New York.
2. Plant Layout and Design, James M Moor, Macmillan, New York.
3. Milk Plant Layout, Hall H S and Y. Rosen, FAO publications, Rome.
4. Principles of Food Sanitation, Marriott N G 1985. Van Nostrand Reinhold Company, New York.
5. Food Technology Processing and Aylward F 2001. Allied Scientific Publishers, Bikaner. Laboratory Control.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Mechanics of Materials (PE-II)			
Course Code	**21AG735**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To provide the basic concepts and principles of strength of materials.
- To give an ability to calculate stresses and deformations of objects under external loadings.
- To give an ability to apply the knowledge of strength of materials on engineering applications and design problems.
-

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Simple stress and strain: Definition/derivation of normal stress, shear stress, and normal strain and shear strain – Stress strain diagram for brittle and ductile materials - Poisson's ratio & volumetric strain – Elastic constants – relationship between elastic constants and Poisson's ratio – Generalised Hook's law – Deformation of simple and compound bars, Resilience, Gradual, sudden, impact and shock loadings – thermal stresses

Teaching-Learning	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations

Process	4. Laboratory Demonstrations and Practical Experiments

Module-2

Bi-axial Stress system: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, graphical method - Mohr's circle for plane stress. Thick and Thin cylinders: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), simple numerical.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-3

Bending moment and Shear forces in beams: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-4

Theory of simple bending – Assumptions – Derivation of bending equation - Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T and Channel sections – Design of simple beam sections, Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, and T sections.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-5

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. Theory of columns – Long column and short column - Euler's formula – Rankine's formula

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Understand the concepts of stress and strain in simple and compound bars.
CO2: Explain the importance of principal stresses and principal planes & Analyse cylindrical pressure vessels under various loadings
CO3: Apply the knowledge to understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment
CO4: Evaluate stresses induced in different cross-sectional members subjected to shear loads
CO5: Apply basic equation of simple torsion in designing of circular shafts & Columns

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnstan, 7th Ed, TATA McGrawHill-2014

2. Mechanics of Materials, K.V.Rao, G.C.Raju, Subhash Stores, First Edition, 2007
3. Strength of Materials by R.K. Bansal ,Laxmi Publications 2010.

Web links and Video Lectures (e-Resources):

1. Statics and Strength of Materials, Shehata, 2nd edition, 1994.
(http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGES/JTE12637J. htm)
2. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGE S/JTE12637J.htm
3. http://www.freeengineeringbooks.com/Civil/Strength-of-MaterialBooks.php

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Mechanics of Tillage and Traction (PE-III)			
Course Code	**21AG741**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To make the students to measure and utilize physical and mechanical properties of soil in order to interpret and predict the soil stress-strain behavior.
- To enable the students to understand the concept of tillage and traction
- To impart the knowledge on traction devices and their performances evaluation

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops

thinking skills such as evaluating, generalizing, and analyzing information.	
Module-1	
Introduction to mechanics of tillage tools: History of Tillage, Soil-Machine Crop System, Mechanics of Tillage Tools, Analysis of Soil-Machine Dynamics In Tillage. Engineering properties of soil, principles and concepts, stress strain relationship : Physical Properties Of Soils, Mechanical Properties Of Soils, Assessment Of The Dynamic Properties Of Soils	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-2	
Design of tillage tools, principles of soil cutting: Design Of Tillage Tools, Mould Board Plow Surfaces, Principles Of Soil Cutting, Deign equation, Force analysis	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Application of dimensional analysis in soil dynamics performance of tillage tools : Dimensional Analysis ,Development of prediction equations, Methods of dimensional analysis, Application of dimensional analysis and similitude to soil mechanics	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Introduction To Traction And Mechanics, Off Road Traction And Mobility: Traction, Traction Mechanics, Off Road Traction , Traction Model, Traction Improvement, Traction Prediction, Cone Index And Tire Basics, Tyre Size, Tyre Lug, Geometry And Their Effects, Tyre Testing, Tire Terminology And Selection Of Tires, Ballasting, Tires For Agricultural Tractors	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	

Soil compaction and plant growth, variability and geo statistics, application of GIS in soil dynamics: Soil Compaction, Mechanical and hydraulic properties of compacted soil, Soil Physical Properties And Plant Growth, Measures For Optimizing Crop Growth by Avoiding Excessive Soil Compaction, Geostatistics / Kriging, GIS For Soil Variability Studies	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Distinguish various dynamic properties of soil and their methods of measurement.
CO2: Analyze the concept of soil tool interaction
CO3: Interpret traction mechanics and prediction models.
CO4: Classify different traction devices and their method of selection based on load and furrow type.
CO5: Evaluation of traction device performance.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Soil Dynamics in Tillage and Traction. Gill & Vandenberg.1968. Supdt. Of Documents, U.S. Govt. Printing Office, Washington, D.C.
2. Sineokov GN. 1965. Design of Soil Tillage Machines. INSDOC, New Delhi.
3. Terzaghi K & Peck Ralph B.1967. Soil Mechanics in Engineering Practices. John Wiley &Sons.

Web links and Video Lectures (e-Resources):

1. http://ecoursesonline.iasri.res.in/course/view.php?id=68
2. https://naldc.nal.usda.gov/download/CAT10309639/PDF
3. https://nptel.ac.in/courses/126105009/8
4. https://www.aftp.co.uk/course/soil-tillage-traction-and-compaction

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Plastic Applications in Agriculture (PE-III)			
Course Code	**21AG742**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To make the students to know the fundamental concepts of plasticulture in field
- To impart knowledge on innovations in Plastic Applications in Agriculture

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

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.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

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	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
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.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
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.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	
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.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Understand the types and quality of plastics used in soil and water conservation, agriculture production and post harvest management and their present status in India
- Make use of plastics in moisture conservation, rain water harvesting lining for seepage control, plastic pipes for irrigation water management, borewell casing, subsurface drainage, drip and sprinkler irrigation system.
- Explain the concepts of soil conditioning and nursery management
- Make Use of plastics in drying, storage and package
- Make use of Plastics for aqua-cultural engineering and animal husbandry

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Brahma Singh, Balraj Singh, Naved Sabir and Murtaza Hasan. 2014.Advances in Protected

Cultivation. New India Publishing Agency, New Delhi.
2. Brown, R.P. 2004. Polymers in Agriculture and Horticulture. RAPRA Review Report
3. Central Pollution Control Board. 2012. Material on Plastic Waste Management. Parivesh
4. Bhawan, East Arjun Nagar, Delhi-110032.
5. Charles A. Harper. 2006. Handbook of Plastics Technologies. The Complete Guide
6. Properties and Performance. McGraw-Hill, New Delhi. 8. Dubois. 1978. Plastics in Agriculture. Applied Science Publishers Limited, Essex, England

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Food Quality and Control (PE-III)			
Course Code	**21AG743**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To enable the students to understand the basics of food science, different quality parameters of food, laws and regulations governing food quality.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Basics of Food Science and Food Analysis, Concept, objectives and need and scope of food quality – general concepts of quality control, major quality control functions. Measurement of colour, flavor, consistency, viscosity, texture and their relationship with food quality and composition.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-2	
Sampling: purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials, Quality control: Quality control tools, Statistical considerations in sampling and quality control	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Sensory evaluation methods, panel selection methods, Interpretation of sensory results;	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	
Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industries. Sanitations and phytosanitary procedures in food industries. Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission). Food processing laws – maintenance of records and reports – traceability and Quality Assurance system in a process plant. Food laws – Role of voluntary agencies and legal aspects of consumer protection.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations

	4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :
CO1: Estimate Measurement of colour, flavor, consistency, viscosity, texture and their relationship with food quality
CO2: Analyze sampling: purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials.
CO3: Interpretation of sensory results. Instrumental method for testing quality.
CO4: Detection of adulteration and examination of various food products
CO5: Discus about Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Ranganna S. 1986. Hand book of Analysis and Quality Control for Fruit and Vegetable Products. TMH, New Delhi.
2. Sharma Avanthi. 2006. A text book of Food Science and Technology, CBS Publishers, New Delhi.
3. The Food Safety and Standards Act along with Rules & Regulations. Commercial Law Publishers (India) Pvt. Ltd. New Delhi.
4. Mumbai Sumati R., Rao Shalini M. and Rajagopal M.V.2006. Food Science, New Age, International, Hyderabad.
5. Potter N. N. and Hotchkiss J. H. 1995 Food Science, Springer, U.S.A.
6. Dev Raj, Rakesh Sharma and Joshi V. K. 2001. Quality Control for Value Addition in Food Processing. New India Publishing Agencies, Delhi

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Design of Agricultural Machinery (PE-III)

Course Code	**21AG744**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives: To enable the students to understand the general procedure for designing any machine parts. To know the design of cotter and knuckle joints, leavers, springs, various types of shafts, couplings bearings and various IC engine parts.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

6. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
7. Chalk and Talk method for Problem Solving.
8. Arrange visits to show the live working models other than laboratory topics.
9. Adopt collaborative (Group Learning) Learning in the class.

10. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Machine Design – Definition, Classification of machine design, General considerations in machine design, General procedure in machine design. Fundamental units, Mass and Weight, inertia, laws of motion, force, moment of force, couple mass density, torque, work, power and energy. Simple stress in machine parts – Introduction, load, stress, strain, tensile stress and strain, compressive stress and strain, Young's modulus, shear stress and strain, shear modulus, bearing stress.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

Stress strain diagram, working stress, Factor of safety and selection, stresses in composite bars, thermal stress, linear and lateral strain, Poisson's ratio, volumetric strain, bulk modulus and relations, impact stress, resilience. Principal stresses and principal planes – Theories of failure under static load, Rankine's theory, Guest's theory, maximum distortion theory, stress concentration, notch sensitivity - Important terms used in Limit System, fits, types of cotter joints, design of socket and spigot cotter joint. Knuckle joint, Dimensions of various parts of knuckles joint, methods of failure of knuckle joint, design

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-3

Levers – Introduction, application of levers in engineering practice, design of lever hand levers, foot lever, cranked lever. Springs – Introduction, types of springs, material for helical springs, spring wire, terminology, springs in series and parallel, flat spiral springs, leaf springs, construction of leaf springs.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-4

Shafts – Material used for shafts, types and sizes of shafts, stresses in shafts, maximum working stresses. Design of shafts, for twisting moment, bending moments, fluctuating loads, axial load in addition to combined twisting and bending loads, design of shafts on the basis of rigidity. Keys and coupling – Introduction, types of keys, sunk keys, saddle keys, tangent keys, round keys, splines, forces acting on sunk keys, strength of sunk key. Effect of key ways, shaft couplings, types of shaft couplings, muff coupling, design of flange coupling.

Teaching-	1. PowerPoint Presentation

Learning Process	2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-5

Design of Machinery: Design of Tillage equipment –a. Cultivator (Manually Drawn and Power Operated); b. Rotavator (Power Operated); c. M.B Plough (Manually Drawn and Power Operated). Design of Sowing Machinery – Tractor Operated seed cum Fertilize drill. Design of harvesting equipment: a. Reaper, b. Mower. Design of Thresher: Power operated thresher (Spike tooth and Rasp bar), Design of spraying equipment – Tractor mounted Boom sprayer.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Analyze the general considerations in machine design.
- Calculate the design Parameters of socket, spigot cotter joint and Knuckle joint.
- Choose appropriate levers and springs for a given application.
- Design shafts and keys for the specified conditions.
- Design Tillage equipment

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Machine Design – Khurmi R.S. and Gupta J.K. 1996, Eurasia Publishing House Pvt. Ltd., New Delhi.
2. Machine Design – Jain R.K. 1991. Khanna Publishers, New Delhi

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Process Equipment Design (PE-III)			
Course Code	**21AG745**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- Impart knowledge on basic principles of designing equipment for food processing
- Become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, driers etc.
- Provide an idea about devising cold storage units, freezers etc.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

PROCESS EQUIPMENT DESIGN: Introduction on process equipment design, principles and selection of food processing equipment Application of design engineering for processing equipment.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

DESIGN PROCEDURE: Design parameters and general design procedure, Material specification, Types of material for process equipment, Design codes, Pressure vessel design, Design of cleaners

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations

	4. Laboratory Demonstrations and Practical Experiments
Module-3	
HEAT EXCHANGER: Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger Problems on tubular heat exchanger, shell and tube type heat exchanger and plate heat exchanger	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
CONVEYING SYSTEM: Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipment.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	
CAD: Optimization of design with respect to process efficiency, energy and cost, Computer Aided Design FOR FURTHER READING Factor of safety, Poisson's ratio, Food grade stainless steel, hygienic design of equipment, hygienic practices during maintenance operation	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Course outcome (Course Skill Set) At the end of the course the student will be able to : CO1: Analyse the various process equipment design. CO2: Understand the design procedure the development of vessels and cleaners. CO3: Analyse the different types heat exchanger methods CO4: Apply the different methods of conveying system CO5: Optimize the variables using CAD for the process equipment design	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

2. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Rajput R K, 2008 Heat and Mass Transfer. S Chand Publishers
2. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
3. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.
4. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi
5. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
6. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London
7. McCabe, W.L., Smith J.C. and Harriott, P. Unit operations of Chemical Engineering. McGraw Hill.
8. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd

Edition.Academic Press, London
Web links and Video Lectures (e-Resources):
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Quizzes • Assignments • Seminars • Mini Projects

Solid Waste & By-Product Utilization (Open Electives-II)			
Course Code	**21AG751**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- Appreciate basic concepts of by-products and waste generation in agricultural production and processing
- Utilize the energy from direct combustion of solid waste
- To convert solid waste into thermo-chemical and Bio-chemical
- To manage the solid waste for bio-utilization
- Effluent treatment and disposal of waste

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

By-products/waste, types of food by-product and waste, magnitude of by-products and waste in food production, magnitude of by-products and wastes in food processing, Waste characteristics, waste management and effluent treatment,

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2

Proximate and ultimate analysis of biomass, theory of combustion, direct combustion of biomass as fuel in furnaces, operating conditions affecting design of furnace. Bales, operation of baler, briquettes, advantages and uses of briquettes. Biomass gasification, gasification process mechanism, types of gasifier reactors, utilization of producer gas,

Teaching-Learning	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general)

Process	3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-3

Biogas, biogas plants, classification of biogas plants, design of biogas plants, comparison among KVIC, Janta and Deenbandhu biogas plants, working of Deenbandhu biogas plant. Selection of proper size of biogas plant, utilization of biogas for cooking purpose, Utilization of biogas for lighting purposes and engine operation,

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-4

Methods of disposal solid waste, Vermin composting, Parameters of effluent like temperature, pH, Oxygen demands (BOD,COD), fat oil and grease content, metal content, forms of phosphorous and sulphur in effluent, Treatment of effluent, steps for waste water treatment, sedimentation, coagulation, flocculation and floatation, Characteristics of food processing waste water, trickling filters, rotating biological contractors, Oxidation ditches, activated sludge process, lagoons,

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-5

Filteration, slow sand filter, rapid sand filter, disinfection of water, Microbiology of waste, bacteriological analysis of water, water borne diseases, insecticide, pesticide and fungicides residues, Management of Pesticide Residues, equipments for estimation of pesticide residue.

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Understand the types and formation of by-products and waste, uses of different agricultural byproducts

CO2: Understand the concept, scope, maintenance of waste management and effluent treatment, Waste water contents and treatments and also familiar with microbiology of waste, ingredients like insecticide, pesticides & fungicides residues.

CO3: Understand utilization of waste in various industries, biomass as fuel, charcoal briquette, and generation of electricity using surplus biomass and remember producer gas generation.

CO4: Understand the design consideration of waste treatment and disposal of community & family size

biogas plants, vermin-composting and pre-treatment of waste

CO5: Familiar with the secondary treatments for food plant wastes, tertiary treatments, effluent treatment plants and environmental performance of food industry

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

5. First assignment at the end of 4th week of the semester
6. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.
2. Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Subtropical fruits and vegetables, AVI Pub. Co.
3. 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.
4. 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.

5. Vasso Oreopoulou and Winfried Russ (Edited). 2007. Utilization of By-products and Treatment
6. G.D. Rai Non-Conventional Energy Sources

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Water Harvesting and Soil Conservation Structures (Open Electives-II)			
Course Code	**21AG752**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

This course deals with water harvesting techniques, runoff harvesting techniques and design of different farm ponds, embankments and spillways. It also helps student to acquaint knowledge in designing and constructing different permanent gully control structures

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

WATER HARVESTING: Water harvesting-principles, importance and issues. Water harvesting techniques- classification based on source, storage and use. Runoff harvesting – short-term and long-term techniques. Short-term harvesting techniques-terracing and bunding, rock and ground catchments. Long-term harvesting techniques - purpose and design criteria. Structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-2	
FARM POND AND EMBANKMENTS: Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction. Percolation pond - site selection, design and construction details. Design considerations of nala bunds. Soil erosion control structures - introduction, classification and functional requirements.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
PERMANENT GULLY CONTROL STRUCTURES: Permanent structures for soil conservation and gully control – check dams, drop, chute and drop inlet spillways - design requirements, planning for design, design procedures-hydrologic, hydraulic and structural design and stability analysis. Hydraulic jump and its application. Drop spillway-applicability, types-straight drop, box-type inlet spillways-description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components and functions.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
DESIGN OF PERMANENT GULLY STRUCTURES: Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	

DESIGN OF PERMANENT GULLY STRUCTURES: Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations. Drop inlet spillway-description, functional use and design criteria.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Apply the knowledge of short term and long term water harvesting techniques to conserve water
CO2: Analyze runoff in watershed and different forces acting on different gully control structures.
CO3: Design and develop farm pond and embankments and optimize its cost.
CO4: Propose and estimate hydrologic design and structural design of different gully control structures.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Books

1. Suresh, R. "Soil and Water Conservation Engineering" Standard Publisher Distributors, New Delhi, 2014.
2. Michael, A.M. and T.P. Ojha. "Principles of Agricultural Engineering" Volume II. 4th Edition, Jain Brothers, New Delhi, 2003.
3. Murthy, V.V.N. "Land and Water Management Engineering" 4th Edition, Kalyani Publishers, New Delhi, 2002.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars
- Mini Projects

Micro irrigation Engineering (Open Electives-II)			
Course Code	**21AG753**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

- To impart knowledge and skills to students to design micro irrigation systems to improve water productivity of different crops and to perform economic analysis and to prepare project proposals and cost estimates of Micro – Irrigation Systems.

Teaching-Learning Process (General Instructions)

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5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Sprinkler Irrigation, Historical development, Scenario in the World, Country and State, adoptability and limitations, Components of the sprinkler system, pump set, (Centrifugal, turbines and Submersible), Main lines, Lateral lines, Sprinkler heads, Debris screens, Desalting basins, booster pumps, Take-off valves, Flow control valves (individual sprinkler).

Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Module-2	
Types of sprinkler Irrigation systems: A. Based on mechanism: i) Rotating head system, ii) Perforated pipe system, B. Based on portability: i) Portable systems, ii) Semi-portable systems, iii) Semi-permanent systems, iv) Permanent systems and v) Solid set systems. Precipitation profiles and Moisture distribution patterns, Recommended sprinkler spacings, Effects of wind speed on working of the system, Importance of distribution uniformity, Christiansen Uniformity coefficient, Distribution uniformity. Suitability of crops under sprinkler irrigation.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-3	
Design of Sprinkler system, layout, laterals and mains: i) Inventory of Resources and Conditions, ii) Types of system and Layout, iii) Sprinkler Selection and Spacing, iv) Capacity of Sprinkler Systems, v) Hydraulic Design of Sprinkler Systems, vi) Selection of pump, Operation and maintenance of system, Field evaluation of the system, Cost analysis.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-4	
Drip Irrigation, Historical development, Scenario in the World, Country and State, Advantages and Limitations, Components of drip irrigation: A. Head Control- Non return valve, Air release & Vacuum breaker, Filter, Fertigation Tank, Throttle valve, Pressure gauge, other fittings, venture type Fertilizer injection pumps. B. Water carrier systems- PVC pipeline, Control valve, Flush valve, other fittings, C. Water distribution systems- Drip lateral, Drippers, Emitting pie, Grommet, Start connector, Nipple, End cap, Micro tube, Barbed connector, Drip Hydraulics, Pipe section, Water flow in pipes, Velocity recommended pressure,	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments
Module-5	
Types of Emitters: A) Based on Floe regime (Reynolds number): i) Laminar Flow, ii)Partially turbulent flow, iii) Fully turbulent flow and B) Based on Lateral connection: i) in-line and ii)online, Emitter flow equation, Emitter constants, Pressure variations (%) for different emitter flow variations and x-values, Emission uniformity (EU), Distribution Uniformity and Irrigation efficiency. Planning and design of drip system- Collection of primary data, Layout, crop water requirements, hydraulic design, selection of components, Economic pipe size selection, Pressure variation Along drip Irrigation and design criteria of lateral, sub-main and mail lines, Pai-wu I design charts. Installation, operation and Maintenance of drip irrigation systems, testing and field evaluation of the system, Computer Software programs for design of	

drip irrigation systems, Automation of drip irrigation systems – i) Volume based, ii) time based and iii) Soil moisture bases systems.	
Teaching-Learning Process	1. PowerPoint Presentation 2. Chalk and Talk are used for Problem Solving (In-general) 3. Video demonstration or Simulations 4. Laboratory Demonstrations and Practical Experiments

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

CO1: Explain the concept of Sprinkler Irrigation and its components.
CO2: Discuss Precipitation profiles and Moisture distribution patterns, sprinkler spacings.
CO3: Design Sprinkler system, layout, laterals and mains.
CO4: Describe drip Irrigation and its components.
CO5: Plan for installation of drip irrigation system.

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CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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Books

1. Drip Irrigation & Sprinkler Irrigation, Sivanappan R K Padma Kumari O and Kumar V 1997, Keerthi Publishing House Pvt. Ltd., Coimbatore.
2. Drip and Sprinkler Irrigation Systems. Nakayama and Prucks.
3. Micro-Irrigation for Crop Production, Design, Operation and Management, Freddie R. Lamm,
4. James E. Ayars and Francis S, Nakayama, 2006, Elsevier Publications, Singapore.
5. Land and Water Management Principles, R. Suresh, 2008, Standard Publishers Distributors, Delhi.

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