NEHRU INSTITUTE OF TECHNOLOGY
AUTONOMOUS

B.Tech AGRICULTURAL ENGINEERING

Curriculum and Syllabi

Regulation 2023

Applicable for the students admitted in

2024

NEHRU INSTITUTE OF TECHNOLOGY
(Autonomous)
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with A+, Recognized by UGC with Section 2(f)
DEPARTMENT OF AGRICULTURAL ENGINEERING

B. Tech AGRICULTURAL ENGINEERING
Curriculum and Syllabi
REGULATION 2023

(Applicable for the students admitted in the year 2024)

VISION AND MISSION OF THE INSTITUTION

VISION

- To be leading Institution in Academic excellence, Multidisciplinary Research, Innovation, Entrepreneurship and Industry relation in order to mould true citizens of the country.

MISSION

- To create innovative and vibrant young leaders in Engineering and Technology field for building India as a knowledge power by improving the teaching-learning process.
- To enhance employability, entrepreneurship and to improve the research competence to address Societal needs.
- To generate engineering graduates who use knowledge as a powerful tool to drive societal transformation and inculcate in them ethical and moral values.

VISION AND MISSION OF THE DEPARTMENT

AGRICULTURAL ENGINEERING

VISION

- Teaching and empowering the students to become fruitful agricultural engineers and entrepreneurs to bring out research competence and innovation to enhance the agricultural sector thereby meeting societal needs.

MISSION

- To mould and develop the students with sound technical knowledge in the fields of farm mechanization, post-harvest technology, irrigation, renewable energy and water management
- To reinforce the research activities and employability skills in agricultural engineering to cultivate graduates as entrepreneurs, scientists and Agriculture Experts.
- To strengthen and expand extension services for livelihood security of farming community.

PROGRAM SPECIFIC OUTCOMES

PSO 1 **Professional Skill**: To provide high quality skills to understand the concepts of Agricultural Engineering problems in worldwide and to provide valuable solutions to improve Agricultural sector.

PSO 2 **Problem solving skill**: To impart the ability to solve complicated problems related to Agricultural Engineering sectors like Soil and water conservation, Post harvest Engineering, Renewable Energy and Farm Mechanization.

PSO 3 **Creativity and Design**: To gain sound knowledge in technical aspects of crop production for optimum management and utilization of available natural resources with managerial skills as well as professional ethics for developing creative and innovative solutions for various agro engineering problems of farming community.

PROGRAM OUTCOMES

PO1 Engineering knowledge: Ability to apply the knowledge of mathematics, science and engineering in agriculture

PO2 Problem analysis: Ability to design and conduct experiments, analyze and interpret data to prepare farm specific report

PO3 Design/development of solutions: Ability to design an irrigation system to meet the desired needs within realistic Constraints such as economic, environmental, social, political, ethical, and sustainability

PO4 Conduct investigations of complex problems: Will develop competencies in computer and automatic control systems, information systems, mechanical systems, natural resource systems to solve engineering problems

PO5 Modern tool usage: Ability to use the techniques, skills and modern engineering tools necessary for Agricultural engineering practice.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team Work: Will develop competencies in computer and automatic control systems, information systems, mechanical systems, natural resource systems to solve engineering problems.

PO10 Communication: Graduates will be able to express themselves clearly in oral and verbal communication needs.

PO11 Project management and finance: Ability to devise a strategy or action plan to utilize the acquired knowledge in increasing water-use efficiency, farm mechanisation and post-harvest technology etc.

PO12 Life-long learning: Graduates will be capable of self-education in emerging problems and understand the value of lifelong learning in Food technology, farm machinery and food processing

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: Develop foundational knowledge essential for industries related to micro-irrigation, tractor and agricultural machinery manufacturing, food processing, and water management.

PEO 2: Equip graduates with an understanding of advanced technologies to design and implement sustainable solutions in agricultural systems.

PEO 3: Collaborate, innovate, and lead in smart agriculture through research, industry, and entrepreneurship.

B. Tech AGRICULTURAL ENGINEERING
REGULATIONS 2023
SEMESTER I

S.No.	Course code	Course title	Category	Periods per week			Total contact periods	Credits
				L	T	P		
1	U23IP101	Induction Program	MC	-	-	-	-	0
2	U23EN101	English for Engineers	HSMC	3	0	0	3	3
3	U23MA101	Calculus and Differential Equations	BSC	3	1	0	4	4
4	U23PH101	Engineering Physics	BSC	3	0	0	3	3
5	U23CY101	Engineering Chemistry	BSC	3	0	0	3	3
6	U23GE101	Engineering Graphics	ESC	2	0	3	5	4
7	U23HS101	Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICAL								
8	U23BS111	Basic Science Laboratory	BSC	0	0	4	4	2
9	U23EN111	Communicative English Laboratory	HSMC	0	0	2	2	1
10	U23GE111	Engineering Practices Laboratory	ESC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
11	U23EE121	Career Enhancement Training - I	EEC	3	0	0	3	1
12	U23VECx1	Vocational Enhancement Training I*	VEC	0	0	2	2	1*
TOTAL				18	1	15	34	24

*Vocational enhancement training is compulsory for all students. The credit earned will be recorded in the grade sheet and included in academic criteria for continuation and not considered for SGPA / CGPA calculation.
Student shall select one of the courses from the list given under VEC

SEMESTER II

S.No.	Course code	Course title	Category	Periods per week			Total contact periods	Credits
				L	T	P		
THEORY								
1	U23MA203	Design of Experiment and Numerical Methods	BSC	3	1	0	4	4
2	U23CE201	Engineering Mechanics	ESC	3	0	0	3	3
3	U23HS202	Tamils and Technology	HSMC	1	0	0	1	1
THEORY COURSE WITH LABORATORY COMPONENT								
4	U23GE202	Basics of Electricals, Electronics and Instrumentation Engineering	ESC	3	0	2	4	4
5	U23EN202	Proficiency in English	HSMC	2	0	2	4	3
6	U23GE203	Python Programming	ESC	2	0	2	4	3
LABORATORY COURSE WITH THEORY COMPONENT								
7	U23AG201	Agronomy and livestock Management	PCC	1	0	4	5	3
EMPLOYABILITY ENHANCEMENT COURSES								
8	U23EE212	Career Enhancement Training – II	EEC	0	0	3	3	1
9	U23VECx2	Vocational Enhancement Training – II*	VEC	0	0	2	2	1*
TOTAL				15	1	15	31	22

SEMESTER III

S.No.	Course Code	Course title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	U23AG301	Fluid Mechanics	PCC	3	0	0	3	3
2	U23AG302	Surveying and Levelling for Agricultural Engineering	PCC	3	0	0	3	3
3	U23MA308	Optimization Techniques	BSC	3	1	0	4	4
THEORY CUM LABORATORY COMPONENT								
4	U23CS203	C Programming	ESC	2	0	2	4	3
5	U23AG202	Soil Science and Engineering	ESC	3	0	2	5	4
6	U23AG303	Theory of Machines	PCC	2	0	2	4	3
PRACTICAL								
7	U23AG311	Fluid Mechanics Laboratory	PCC	0	0	2	2	1
8	U23AG312	Surveying and Levelling Laboratory for Agricultural Engineering	PCC	0	0	2	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
9	U23EE313	Aptitude and Communication for Engineers -I	EEC	0	0	3	3	1
10	U23VEx3	Vocational Enhancement Training – III*	VEC	0	0	2	2	1*
				16	1	15	32	23

SEMESTER IV

S.No.	Course Code	Course title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	U23AG401	Thermodynamics and Heat Transfer	PCC	3	0	0	3	3
2	U23AG402	Hydrology and Water Resources Engineering	PCC	3	0	0	3	3
3	U23AG403	Strength of Materials for Agricultural Engineering	PCC	3	0	0	3	3
4	U23AG404	Farm Tractors and Engine System	PCC	3	0	0	3	3
5	U23CY402	Environmental Ecosystem and Sustainability	BSC	2	0	0	2	2
THEORY CUM LABORATORY COMPONENT								
6	U23AG405	Unit Operations in Agricultural Processing	PCC	3	0	2	5	4
PRACTICAL								
7	U23AG411	Strength of Materials for Agricultural Engineering Laboratory	PCC	0	0	4	4	2
8	U23AG412	Farm Tractors and Engine System Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
9	U23EE414	Aptitude and Communication for Engineers - II	EEC	0	0	3	3	1
10	U23VEx4	Vocational Enhancement Training – IV*	VEC	0	0	2	2	1*
				17	0	15	32	23

SEMESTER V

S.No.	Course Code	Course title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	U23AG501	Agricultural Extension	PCC	2	0	0	2	2
2		Professional Elective I	PEC	3	0	0	3	3
3		Professional Elective II	PEC	3	0	0	3	3
4		Professional Elective III	PEC	3	0	0	3	3
5	U23MC504	Entrepreneurship and Innovation	MC	2	0	0	2	0
THEORY CUM LAB COMPONENT								
6	U23AG502	Farm Machinery and Equipment	PCC	3	0	2	5	4
PRACTICAL								
7	U23AG511	Design and Drafting of Agricultural Machinery Elements	PCC	0	0	4	4	2
8	U23AG512	Internship	EEC	0	0	0	0	1
EMPLOYABILITY ENHANCEMENT COURSES								
9	U23EE517	Campus to Corporate - I	EEC	0	0	3	3	1
10	U23VECx5	Vocational Enhancement Training – V*	VEC	0	0	2	2	1*
				16	0	11	27	19

SEMESTER VI

S.NO.	Course Code	Course title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	U23AG601	Food and Dairy Engineering	PCC	3	0	0	3	3
2		Professional Elective IV	PEC	3	0	0	3	3
3		Professional Elective V	PEC	3	0	0	3	3
4		Professional Elective VI	PEC	3	0	0	3	3
5		Open Elective – I	OEC	3	0	0	3	3
6		Mandatory Course II	MC	2	0	0	2	0
THEORY CUM LAB COMPONENT								
7	U23AG602	Irrigation and Drainage Engineering	PCC	3	0	2	5	4
8	U23AG603	Renewable Energy in Agricultural Engineering	PCC	3	0	2	5	4
PRACTICAL								
9	U23EE618	Campus to Corporate - II	EEC	0	0	0	0	1
10	U23VECx6	Vocational Enhancement Training – VI*	VEC	0	0	2	2	1*
				23	0	6	29	24

SEMESTER VII

S.No.	Course Code	Course title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	U23AG701	Soil and water Conservation Engineering	PCC	3	0	0	3	3
2	U23AG702	Remote Sensing and Geographical Information System	PCC	3	0	0	3	3
3	U23AG703	Automation in agriculture	PCC	3	0	0	3	3
4		Open Elective – II	OEC	3	0	0	3	3
5		Open Elective -III	OEC	3	0	0	3	3
6		Open Elective -IV	OEC	3	0	0	3	3
PRACTICAL								
7	U23AG711	Remote Sensing and GIS Laboratory	PCC	0	0	4	4	2
				18	0	4	22	20

SEMESTER VIII

S.No.	Course Code	Course title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
PRACTICAL								
1	U23EE809	Project work	EEC	0	0	20	20	10
				0	0	20	20	10

Total No. of Credits: 165

SUMMARY												
S.No.	**Course Category**		**Credits per Semester**								**Credits**	**Credit%**
			I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1	Department Specific Core **DSC**	HSMC	5	4	-	-	-	-	-	-	10	6
2		BSC	12	4	4	2	-	-	-	-	22	13
3		ESC	6	10	7	-	-	-	-	-	17	10
4		PCC	-	3	11	20	8	11	11	-	69	43
5	Department Specific Elective **DSE**	PEC	-	-	-	-	9	9	3	-	18	11
6	Generic Elective **GE**	OEC	-	-	-	-	-	3	6	-	9	6
7	Internship/ Project	EEC	1	1	1	1	2	1	-	10	18	11
8	Mandatory Course	MC	-	-	-	-	2*	2*	-	-	0	-
9	Skill Enhancement Course	SEC	-	-	-	-	-	-	-	-	0	-
10	Vocational Enhancement Course	VEC	1*	1*	1*	1*	1*	1*	-	-	6*	-
11	Ability Enhancement Course	AEC		-	-		-				0	-
Total			**24**	**22**	**23**	**23**	**19**	**24**	**20**	**10**	**165**	**100%**

PROFESSIONAL ELECTIVE COURSE: VERTICALS

VERTICAL I **Food and Agricultural Processing**	**VERTICAL II** **Farm Machinery and Energy**	**VERTICAL III** **Water Management and Protected cultivation**	**VERTICAL IV** **Sustainable Agriculture and Management**
Refrigeration and Air Conditioning	Special Precision Farm Equipment	Groundwater and Well Engineering	Integrated Farming System
Post Harvest Technology	Testing and Evaluation of farm equipment	Command Area Development	Agricultural Business Management
Processing of Fruits and Vegetables	Human Engineering and Safety	Design of Micro-irrigation system	Sustainable Agriculture and Food Security
Storage and Packaging Technology	Mechanics of Tillage and Traction	Protected Cultivation	Rural and Environmental Engineering
Food Process Equipment and Design	Bio Energy Resource Technology	Basics of Integrated Water Resource Management	Principles of Organic farming
Food Quality analysis and Control	Agricultural Waste Management	Climate change and Adaptation	IoT in Agriculture
Advanced Technologies in Food Processing	Solar and Wind energy system	Watershed Development and Management	Landscape architecture

VERTICAL I - FOOD AND AGRICULTURAL PROCESSING

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23AGP11	Refrigeration and Air Conditioning	PEC	3	0	0	3	3
2	U23AGP12	Post Harvest Technology	PEC	3	0	0	3	3
3	U23AGP13	Processing of Fruits and Vegetables	PEC	3	0	0	3	3
4	U23AGP14	Storage and Packaging Technology	PEC	3	0	0	3	3
5	U23AGP15	Food Process Equipment and Design	PEC	3	0	0	3	3
6	U23AGP16	Food Quality analysis and Control	PEC	3	0	0	3	3
7	U23AGP17	Advanced Technologies in Food Processing	PEC	3	0	0	3	3

VERTICAL II - FARM MACHINERY AND ENERGY

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23AGP21	Special Precision Farm Equipment	PEC	3	0	0	3	3
2	U23AGP22	Testing and Evaluation of farm Machinery and equipment	PEC	3	0	0	3	3
3	U23AGP23	Human Engineering and Safety	PEC	3	0	0	3	3
4	U23AGP24	Mechanics of Tillage and Tractio	PEC	3	0	0	3	3
5	U23AGP25	Bio Energy Resource Technology	PEC	3	0	0	3	3
6	U23AGP26	Agricultural Waste Management	PEC	3	0	0	3	3
7	U23AGP27	Solar and Wind energy system	PEC	3	0	0	3	3

VERTICAL III - WATER MANAGEMENT AND PROTECTED CULTIVATION

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23AGP31	Groundwater and Well Engineering	PEC	3	0	0	3	3
2	U23AGP32	Command Area Development	PEC	3	0	0	3	3
3	U23AGP33	Design of Micro-irrigation system	PEC	3	0	0	3	3
4	U23AGP34	Protected Cultivation	PEC	3	0	0	3	3
5	U23AGP35	Basics of Integrated Water Resource Management	PEC	3	0	0	3	3
6	U23AGP36	Climate change and Adaptation	PEC	3	0	0	3	3
7	U23AGP37	Watershed Development and Management	PEC	3	0	0	3	3

VERTICAL IV - SUSTAINABLE AGRICULTURE AND MANAGEMENT

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23AGP41	Integrated Farming System	PEC	3	0	0	3	3
2	U23AGP42	Agricultural Business Management	PEC	3	0	0	3	3
3	U23AGP43	Sustainable Agriculture and Food Security	PEC	3	0	0	3	3
4	U23AGP44	Rural and Environmental Engineering	PEC	3	0	0	3	3
5	U23AGP45	Principles of Organic farming	PEC	3	0	0	3	3
6	U23AGP46	IoT in Agriculture	PEC	3	0	0	3	3
7	U23AGP47	Landscape architecture	PEC	3	0	0	3	3

HONOURS DEGREE - VERTICAL V - SMART AGRICULTURE

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23AGP51	Agricultural Structures	HON	3	0	0	3	3
2	U23AGP52	Soil Fertility and Nutrient Management	HON	3	0	0	3	3
3	U23AGP53	Principles of Organic Farming	HON	3	0	0	3	3
4	U23AGP54	Seed Processing Technology	HON	3	0	0	3	3
5	U23AGP55	Mushroom Cultivation and Vermicomposting	HON	3	0	0	3	3
6	U23AGP56	High Tech Farming Systems	HON	3	0	0	3	3
7	U23AGP57	Drone Technology in Agriculture	HON	3	0	0	3	3
8	U23AGP58	Agri Startups, Entrepreneurship and Innovation	HON	3	0	0	3	3

OPEN ELECTIVES OFFERED BY AGRICULTURAL ENGINEERING

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23AGO11	Sustainability and Green Building	OEC	3	0	0	3	3
2	U23AGO12	Precision Farming	OEC	3	0	0	3	3
3	U23AGO13	Urban Agriculture	OEC	3	0	0	3	3
4	U23AGO14	Organic Farming	OEC	3	0	0	3	3
5	U23AGO15	Integrated Farming System	OEC	3	0	0	3	3
6	U23AGO16	Renewable Energy System	OEC	3	0	0	3	3

MANDATORY COURSES

S.No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1		Introduction to Women and Gender Studies	MC	3	0	0	3	0
2		Elements of Literature	MC	3	0	0	3	0
3		Film Appreciation	MC	3	0	0	3	0
4		Disaster Risk Reduction and Management	MC	3	0	0	3	0
5		Well Being with Traditional Practices – Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
6		History of Science and Technology in India	MC	3	0	0	3	0
7		Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
8		State, Nation Building and Politics in India	MC	3	0	0	3	0
9		Industrial Safety	MC	3	0	0	3	0
10		Intellectual Property Rights	MC	3	0	0	3	0
11		Entrepreneurship and Innovation	MC	3	0	0	3	0

*Mandatory Courses are offered as Non-Credit Courses

SEMESTER I

U23EN101 **ENGLISH FOR ENGINEERS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1 To enable learners of engineering and technology to develop their basic communication skills in English.
2 To acquire, command in both the respective skills (listening and reading) and the productive skills (writing and speaking) of the English language.
3 To understand the key concepts of values, life skills and business communication and motivate students to look within and create a better version of themselves.
4 To focus on the development of basic fluency in English, usage of vocabulary in the technical field, and strengthening reading and official written communication skills.
5 To use language efficiently in expressing their opinions via various media.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Listen and comprehend complex academic texts
CO2: Understand the denotative and connotative meanings of technical texts.
CO3: Identify definitions, descriptions, narrations and essays on various topics.
CO4: Apply different methods of integration in solving practical problems
CO5: Express their opinions effectively in both oral and written medium of communication.

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	-	3	1	-	2	-	-	-
2	-	-	-	-	-	1	1	-	3	-	-	2	-	-	-
3	-	-	-	-	-	1	1	-	3	2	-	3	-	-	-
4	-	-	-	-	-	1	2	-	3	1	-	2	-	-	-
5	-	-	-	-	-	1	2	-	3	2	-	3	-	-	-
Avg.	-	-	-	-	-	1	1	-	3	1	-	2	-	-	-

UNIT 1 **INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION** **09**

Listening – listening to Audio/ video (formal & informal); Telephonic conversation (Activity) Speaking - Self Introduction; Introducing a friend (Activity); Conversation - politeness strategies; Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts-Writing - Writing oneself, Writing Definition; Jumbled sentence Grammar – Simple present tense, Present continuous, Present perfect, Present perfect continuous; Question types: Wh/ Yes or No/ and Tags; Word formation, One-word substitution

UNIT 2 **NARRATION AND SUMMATION** **09**

Listening - Listening to the podcast, anecdotes/stories/ event narration; documentaries and interviews with celebrities (Activity). Speaking - Narrating

personal experiences / events; interviewing a celebrity (Activity). Reading - Reading biographies, travelogues, newspaper reports, Writing - Guided writing- Paragraph writing, Short Report on an event (field trip etc.) - Grammar – Simple past tense, Past continuous, Past perfect, Past perfect continuous; Subject-Verb Agreement; Prepositions, Word forms (prefixes& suffixes); Error Correction

UNIT 3 **DESCRIPTION OF PROCESS/PRODUCT** **09**

Listening – Listening to specific audio tracks (Activity) Speaking – Picture description; giving instruction to use the product; presenting a product; Role play (Activity) -Reading – Reading advertisements, gadget reviews; finding key information from a given text- Writing - Instructions; Process description; Grammar - Simple future tense, Future continuous, Future perfect, Future perfect continuous; Imperatives; Adjectives; Degrees of comparison; Compound Words.

UNIT 4 **CLASSIFICATION AND RECOMMENDATIONS** **09**

Listening – watching videos/ documentaries and responding to the questions based on them, Scientific lectures; and educational videos. Speaking – Small Talk; Mini presentations (Activity) -Reading – Journal reports, predicting content of reading habits, Reading articles (Activity)- Writing –Memos to colleagues or friends; Opinion Blogs; Grammar – Articles; Pronouns - Possessive & Relative pronouns, Cause and Effect

UNIT 5 **EXPRESSION** **09**

Listening – Listening to different accent, listening to speeches or presentation- Speaking – Debates and Expressing opinions through Simulations, exchanging personal information - (Activity)- Reading – Reading editorials; Poster making (Activity) - Writing – Creative Writing, Checklist- Grammar –Punctuation; Compound Nouns, Homonyms; and Homophones, Simple, Compound & Complex Sentences

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University

REFERENCE BOOKS:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

U23MA101 CALCULUS AND DIFFERENTIAL EQUATIONS

L	T	P	C
3	**1**	**0**	**4**

COURSE OBJECTIVES:

1 To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2 To familiarize the students with differential calculus.
3 To enlighten the students with functions of several variables. This is needed in many branches of engineering.
4 To make the students acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
5 To acquaint the students with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Comprehend the concepts of Eigen values, Eigen vectors, limits, continuity, functions of several variables, double integration and region of integration for solving complex problems
CO2: Use rules of differentiation to solve maxima and minima problems
CO3: Apply various techniques in solving ordinary and partial differential equations for practical applications
CO4: Apply differential and integral calculus tools in modeling problems
CO5: Evaluate integrals to compute area, volume and other practical problems

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
3	3	3	2	-	1	-	-	-	-	-	-	-	-	-	-
4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-
Avg.	3	3	2.2	1	1	-	-	-	-	-	-	-	-	-	-

UNIT 1 MATRICES **09 + 03**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation

UNIT 2 DIFFERENTIAL CALCULUS **09 + 03**

Representation of functions - Limit of a function - Continuity - Derivatives -

Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT 3 MULTIVARIABLE CALCULUS 09 + 03

Functions of two variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Jacobian's – Constrained maxima and minima – Lagrange's multiplier and its applications.

UNIT 4 ORDINARY DIFFERENTIAL EQUATIONS OF SECOND ORDER 09 + 03

Linear differential equations of second order with constant coefficients. Linear differential Equations of second order with variable coefficients: Cauchy's linear differential equation - Method of variation of parameters for second order differential equations

UNIT 5 MULTIPLE INTEGRALS 09 + 03

Double integration with constant and variable limits - Region of integration - Area as double integral in Cartesian coordinates. Triple integral in Cartesian coordinates. Application of integration – Volume of Solids

TEXT BOOKS:

1 Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
2 James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.
3 Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCE BOOKS:

1 Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009
2 Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
3 Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
4 Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5 Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
6 Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015.

U23PH101 ENGINEERING PHYSICS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Understand the basics of Properties of Matter and apply them to Engineering.
2 Explore the applications of Lasers and Fiber optics in Engineering contexts.

3 Apply principles of Ultrasonics and Thermal Physics to Engineering challenges.

4 Grasp foundational Quantum Physics concepts and their modern applications.

5 Analyse Crystal systems and their structures in Engineering and Technology.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Realize the fundamental engineering ideas of matter, optics, heat, sound, and quantum theory.

CO2: Demonstrate a solid understanding of fundamental matter properties, Laser and Fiber optics classification, Quantum concepts and apply them successfully to solve practical engineering problems

CO3: Apply the elastic modulus theory, Fiber Optic Sensors, Ultrasonics and thermal applications to integrate knowledge and problem solve at an advanced level.

CO4: Categorize the Elastic moduli concepts, Fiber optic lasers and Crystal structures to implement in Engineer problems in Material Science and electronics

CO5: Analyze the foundational Quantum and Crystal Physics concepts to implement solutions for modern engineering problems.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	-	1	-	1	-	-	1	-	1	-	-	-
2	3	3	1	-	1	-	1	-	1	-	-	1	-	-	-
3	3	3	1	-	1	-	1	-	1	-	-	1	-	-	-
4	3	2	1	-	1	-	-	-	-	1	-	1	-	-	-
5	3	3	1	-	-	-	1	-	1	-	-	1	-	-	-
Avg.	3	2.8	1	-	0.8	-	0.8	-	0.6	0.4	-	1	-	-	-

UNIT 1 **PROPERTIES OF MATTER** **09**

Elasticity – Stress-strain diagram and its uses - Factors affecting elastic modulus – Torsional stress and deformations –Torsion pendulum: theory and experiment - Bending of beams - Bending moment – Cantilever: theory and experiment – Uniform and non-uniform bending: theory and experiment - I-shaped girders - Applications. – Basic Solved Problems.

UNIT 2 **LASER AND FIBER OPTICS** **09**

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping- Einstein's A and B coefficients: derivation. Types of lasers – Nd-YAG, CO_2- Industrial Applications of Lasers –Fiber Optics: Principle and propagation of light – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Temperature and displacement sensors.

UNIT 3 **ULTRASONICS AND THERMAL PHYSICS** **09**

Introduction – Piezoelectric effect - piezoelectric generator - Velocity measurement – Acoustic grating – Ultrasonic Medical applications - Introduction to heat - Transfer of heat energy: Thermal conduction, convection and radiation – Thermal conductivity - Forbe's and Lee's disc method: theory and experiment – Applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 **QUANTUM PHYSICS** **09**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jeans' Law from Planck's theory – Compton effect: Theory and experimental verification – Matter waves – Schrödinger's wave equation: Time independent and time dependent equations – Physical significance of wave function – Particle in a one-dimensional box - Microscope: Scanning Tunnelling microscope.

UNIT 5 **CRYSTAL PHYSICS** **09**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures – Polymorphism and allotropy - Crystal defects – Point, line and surface defects- Burger vector.

TEXT BOOKS:

1 Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2 Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3 Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCE BOOKS:

1 Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2 Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3 Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
4 Kittle,C,: Introduction to solid state Physics:, Wiley, 2005.
5 Mani P. Engineering Physics I. Dhanam Publications, 2011.
6 Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

U23CY101 **ENGINEERING CHEMISTRY**

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Learn boiler feed water requirements, and water treatment techniques.
2 To acquire knowledge about the preparation, properties and applications of polymers

3 Understand the basic concepts of electrochemistry and its applications.

4 Learn corrosion control and protective techniques.

5 Acquire the knowledge about the fuels and properties of energy storage devices.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall the concept about water technology, engineering polymers, electrodes, corrosion and combustion of fuels.

CO2: Understand the boiler problems and categorize the polymers.

CO3: Classify plastics, batteries, corrosion, and the calorific value of fuels

CO4: Apply enough knowledge of contemporary water softening, polymerization, fuel cell, electrochemical protection, and fuel manufacturing procedures.

CO5: Analyze the hardness of water using the EDTA technique and characterization of coal.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	2	-	-	2	-	-	-	-	1	-	-	-
2	3	-	-	2	2	-	2	-	-	-	-	2	-	-	-
3	3	-	-	2	2	-	2	-	-	-	-	2	-	-	-
4	3	-	-	2	3	-	2	-	-	-	-	3	-	-	-
5	3	-	-	2	3	-	2	-	-	-	-	3	-	-	-
Avg.	3	-	-	2	2	-	2	-	-	-	-	2.2	-	-	-

UNIT 1 WATER TECHNOLOGY **09**

Introduction - Sources of water - Impurities in water - Types of water –Hardness of water - Expression of hardness - Units of hardness - Estimation of hardness of water by EDTA method - Disadvantages of using hard water - Boiler troubles - Scale and sludge - Softening of water - External treatment method - Demineralization process - Internal treatment process – Carbonate, Phosphate and Calgon conditioning - Desalination by reverse osmosis method.

UNIT 2 POLYMERS **09**

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types: Addition, condensation and copolymerization and mechanism of Addition polymerization (Free Radical); Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon (6,6 and 11) and Epoxy resin. Engineering application of plastics- PVC, PTFE and Bakelite. Types of compounding of plastics- Moulding, injection moulding

UNIT 3 **ELECTRO CHEMISTRY** **09**

Electrochemistry**:** Introduction - Cells - Representation of a galvanic cell - Reversible and irreversible cells - Electrode potential - Nernst equation - Reference electrode (Calomel electrode) - Standard hydrogen electrode - Glass electrode - Electrochemical series and its applications – Battery: Introduction, Types of batteries- alkaline battery- lead storage battery - H_2 -O_2 fuel cell- applications. Construction of solar cells and E-Vehicle.

UNIT 4 **CORROSION AND ITS CONTROL** **09**

Introduction - Chemical corrosion and Wet corrosion - Galvanic and differential aeration (Pitting, Crevice and Pipeline) - Factors influencing rate of corrosion - Corrosion- causes- factors- corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method- Cathodic protection method.

UNIT 5 **FUELS AND COMBUSTION** **09**

Introduction - Classification of fuels - Requirements of a good fuel – Combustion: Principle of combustion - Calorific value - Gross and net calorific values - Explosive range - Spontaneous ignition temperature. Fuels: Solid fuels - Coal and its varieties - Proximate analysis - Significance - Metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel: Manufacture of synthetic petrol - Bergius method - Knocking - Octane number - Cetane number - Gaseous fuel: Liquefied petroleum gas (LPG), Compressed natural gas (CNG).

TEXT BOOKS:

1 Jain P C and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Co., 2018.
2 Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017.

REFERENCE BOOKS:

1 B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Textbook of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2 O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3 Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt, Ltd, New Delhi, 2017.
4 Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5 R.D. Madan, “Modern Inorganic Chemistry”, S. Chand, New Delhi, 2012
6 S.S. Dara, “A Textbook of Engineering Chemistry”, S. Chand Publishing, 12th Edition, 2018.

U23GE101 **ENGINEERING GRAPHICS**

L	T	P	C
2	0	3	4

COURSE OBJECTIVES:

1 Draw engineering curves of simple objects.
2 Draw the orthographic projection of solids and section of solids.
3 Draw the development of surfaces.
4 Draw the isometric projections of simple solids.
5 Model a simple object using a CAD software.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Understand the engineering curves of simple objects.
CO2: Create drawings on orthographic views.
CO3: Use the knowledge of orthographic Projections of simple solids.
CO4: Draw the development of lateral surface of simple Solids.
CO5: Draw the isometric projection of simple plans and solids
CO6: Model a simple object using a CAD software.

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	-	-	-	-	-	1	-	1	2	-	-
2	3	3	2	-	-	-	-	-	-	1	-	1	2	2	-
3	3	2	-	-	-	-	-	-	-	1	-	1	2	-	-
4	3	3	2	-	-	-	-	-	-	1	-	1	2	2	-
5	3	3	2	-	-	-	-	-	-	1	-	1	2	2	-
Avg.	3	2	2	-	3	-	-	-	-	1	-	2	2	2	1

CONCEPTS AND CONVENTIONS (Not for Examination) **02**

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets - Lettering and dimensioning.

UNIT 1 **PLANE CURVES** **10**

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - Construction of involutes of circle - Drawing of tangents and normal to the above curves.

UNIT 2 **PROJECTION OF POINTS, LINES AND PLANES** **10**

Orthographic projection - principles - Principal planes - First angle projection - projection of points. Projection of straight lines - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces).

UNIT 3 **PROJECTION OF SOLIDS** **10**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids by rotating object method.

UNIT 4 **PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES** **10**

Sectioning of solids in simple vertical position - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones.

UNIT 5 **ISOMETRIC PROJECTIONS** **10**

Principles of isometric projection - isometric scale - lsometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones.

MODELING OF SIMPLE OBJECTS (Not for Examination) **08**

TEXT BOOKS:

1 Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.
2 Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3 Jeyapoovan T., “Engineering Graphics", Newdelhi Vikas Publishing House, 2007.

REFERENCE BOOKS:

1 Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
2 Kulkarni D; Rastogi; Sarkar, “Engineering Graphics with AUTOCAD”, Newdelhi Prentice Hall of India, 2009.

U23HS101 **HERITAGE OF TAMILS**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

1 To learn the extensive literature of classical tamil
2 To review the fine arts heritage of tamil culture
3 To realize the contribution in Indian freedom struggle

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Remember the extensive literature of Tamil and its classical nature, musical instruments, Folk, thinai concept, Indian Freedom Struggle& Aham, Puram and Aram Concept.

CO2: Remember the principles in Thirukural, Bakthi Literature Azhwars and Nayanmars,

heritage of sculpture, painting and musical instruments of ancient people, victory of chozha dynasty

CO3: Understand on folk and martial arts of Tamil people, Justice in Sangam Literature, Development of Modern literature in Tamil, Making of musical instruments

CO4: Understand the role of Temples in Social and Economic Life of Tamils, Ancient Cities and Ports of Sangam Age, Conquest of Cholas

CO5: Understand the Cultural Influence of Tamils over the other parts of India, contribution of Tamils self-esteem movement and siddha medicine, Print History of Tamil Books

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
Avg.	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

UNIT 1 **LANGUAGE AND LITERATURE** **03**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT 2 **HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE** **03**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT 3 **FOLK AND MARTIAL ARTS** **03**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT 4 **THINAI CONCEPT OF TAMILS** **03**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT 5	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**03**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TEXT BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – . கே. கே பிள்ளை (வெளியீடு): தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை (வெளியீடு)

REFERENCE BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
4. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
5. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

		L	T	P	C
U23BS111	**BASIC SCIENCE LABORATORY**	**0**	**0**	**4**	**2**

COURSE OBJECTIVES:

1. Learn the proper use of various kinds of physics laboratory equipment's
2. Understand how data can be collected, presented and interpreted in a clear and crisp manner.
3. Learn the problem-solving skills related to physics principles and interpretation of experimental data
4. Make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
5. Develop the ability to explain the processes and to determine the amount of metal ion and strength of acids by instrumental analysis.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Apply Physics principles of elasticity to evaluate engineering properties of materials.

CO2: Analyze the physical principle involved in various instruments in acoustics, optics and thermal physics

CO3: Characterize the quality of water samples with respect to their acidity, alkalinity and hardness

CO4: Apply chemistry principles to evaluate DO, BOD, Iron content of the given samples

CO5: Analyze the strength and amount of acids using pH, potentiometer, conductivity meter and the amount of chloride, sodium iron using Argentometric method and flame photometer for the given solution.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	2	-	-	-	-	1	-	-	1	1	-	-
2	3	2	-	3	2	-	-	-	1	-	-	1	1	-	-
3	3	3	-	3	2	-	2	-	1	-	-	1	1	2	-
4	3	3	-	3	2	-	2	-	1	-	-	1	1	2	-
5	3	3	-	3	2	-	-	-	1	-	-	1	1	2	-
Avg.	3	2.6	-	2.8	1.6	-	0.8	-	1	-	-	1	1	1.2	-

S.NO **PHYSICS - LIST OF EXPERIMENTS (Any 5 Experiments)**

1 Determination of rigidity modulus – Torsion pendulum
2 Determination of Young's modulus - Non uniform bending method.
3 Determination of Young's modulus - Uniform bending method
4 Determination of thickness of a thin wire – Air wedge method
5 Determination of the wavelength of the laser using grating
6 Determination of Numerical Aperture and acceptance angle using Optical fibre
7 Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
8 Determination of thermal conductivity of a bad conductor – Lee's Disc method.
9 Melde's string experiment
10 Determination of Band gap of a semiconductor

S.NO **CHEMISTRY- LIST OF EXPERIMENTS (Any 5 Experiments)**

1 Estimation of total, temporary and permanent hardness of water by EDTA method.
2 Estimation of alkalinity of the given water sample.
3 Determination of chloride content of water sample by Argentometric method.
4 Determination of strength of given hydrochloride acid using pH meter
5 Determination of DO content of water sample by Winkler's method.
6 Conductometric titration strong acid Vs Strong Base.
7 Estimation of BOD of the given water sample.

8 Estimation of iron content of the given solution using potentiometer.
9 Estimation of Iron content by spectrophotometer
10 Estimation of sodium present in water using flame photometer.

U23GE111	**ENGINEERING PRACTICES LABORATORY** (Common for all the branches)	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

1 Drawing pipe line plan; laying and connecting various pipe fittings used in common householdplumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2 Welding various joints in steel plates using arc welding work; Machining various simple processeslike turning, drilling, tapping in parts.
3 Assembling simple mechanical assembly of common household equipments; Making a tray out ofmetal sheet using sheet metal work.
4 Wiring various electrical joints in common household electrical wire work.
5 Soldering and testing simple electronic circuits; Assembling and testing simple electroniccomponents.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Fabricate carpentry components and pipe connections including plumbing works.
CO2: Use welding equipment to join the structures
CO3: Carry out the basic assembling and machining operations; Make the models using sheet metal works
CO4: Carry out basic home electrical works and appliances and to measure the electrical quantities
CO5: Soldering the simple electronic circuits; Assemble the simple electronic devices.

CO-PO MAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2			1	1	1					2	2	1	1
2	3	2			1	1	1					2	2	1	1
3	3	2			1	1	1					2	2	1	1
4	3	2			1	1	1					2	2	1	1
5	3	2			1	1	1					2	2	1	1
Avg.	**3**	**2**			**1**	1	1					2	2	**1**	**1**

S.NO **LIST OF EXPERIMENTS**

GROUP A (CIVIL & MECHANICAL)

PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

1 Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows andother components which are commonly used in household.

2 Preparing plumbing line sketches.

3 Basic pipe connections – Mixed pipe material connection – Pipe connections with different joiningcomponents.

WOOD WORK:

4 Sawing,

5 Planing and

6 Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

PART II MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

7 Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

8 Practicing gas welding.

BASIC MACHINING WORK:

9 (simple)Turning

10 (simple)Drilling.

11 (simple)Tapping.

MACHINE ASSEMBLY PRACTICE:

12 Study of centrifugal pump

13 Study of air conditioner

SHEET METAL WORK:

14 Making of a square tray

GROUP B (ELECTRICAL & ELECTRONICS)

PART I ELECTRICAL ENGINEERING PRACTICES

1 Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fanand three pin sockets.

2 Staircase wiring.

3 Fluorescent Lamp wiring with introduction LED types.

4 Energy meter wiring and related calculations/ calibration

5 Study of Iron Box wiring and assembly

SEMESTER II

U23MA203	**DESIGN OF EXPERIMENT AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

1. Learn basic concepts of statistical and numerical methods as well as numerical problem-solving procedure for planning marketing strategies
2. Gain the knowledge of testing of hypothesis for samples and design of experiments
3. Understand the basic concepts in solving algebraic and transcendental equations
4. Adopt the numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines
5. Develop the various techniques and methods of solving ordinary differential equations

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Comprehend the concepts of Independence of attributes, one way and two-way classifications, Solution of algebraic and transcendental equations for solving complex problems.

CO2: Tests for single mean, Equality of variance, Chi square test for goodness of fit and Solution of linear equations

CO3: Apply the numerical techniques of differentiation and integration for engineering problems and solving Ordinary Differential Equations.

CO4: Analyze the concepts of classifications of design of experiments and linear equations in the field of Engineering and Technology.

CO5: Solve the ordinary differential equations using certain techniques with engineering applications.

CO-PO MAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	-	-	-	-	-	2.5	-	-
2	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
3	3	3	3	2	-	-	-	-	-	-	-	-	2.75	-	-
4	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
5	3	3	3	2	-	-	-	-	-	-	-	-	2.75	-	-
Avg.	**3**	**3**	**2.8**	**2.4**	-	-	-	-	-	-	-	-	2.8	-	-

UNIT 1 **TESTING OF HYPOTHESIS** **9 + 3**

Large Sample Test: Single Mean and Difference of two Means. Small Sample Test - Student's t Test - Single Mean-Difference of Two Means-F Test- Chi Square Test-

Goodness of Fit - Test of Independence Attributes – Application- Comparative Analysis - Quality Testing.

UNIT 2 DESIGN OF EXPERIMENTS **9 + 3**

Analysis of Variance: One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design. Application: Response Surface Methodology.

UNIT 3 ALGEBRAIC AND TRANSCENDENTAL EQUATIONS **9 + 3**

Solution of algebraic and transcendental equations–Newton Raphson method - Gauss elimination method –Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel Method. Application: System of Communications.

UNIT 4 NUMERICAL DIFFERENTIATION AND INTEGRATION **9 + 3**

Interpolation Using Newton's Forward and Backward Difference Formulae – Numerical Integration (Single): Trapezoidal Rule and Simpson's 1/3rd and 3/8 Rules. Application: The determination of discontinuous points in Image processing.

UNIT 5 SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9 + 3**

Taylor's series method - Euler's method - Modified Euler's method – Fourth orders Runge-Kutta method for solving first order differential equations. Application: Electrical circuits, Chemical reactions and Mechanical system.

TEXT BOOKS:

1 Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

2 Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015

REFERENCE BOOKS:

1 Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016

2 Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014

3 Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, New Delhi, 12th Edition, 2020

4 Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014

U23CE201	ENGINEERING MECHANICS	L	T	P	C
		3	2	0	3

PREREQUISITES:

Prerequisites for Engineering Mechanics typically include a strong foundation in calculus, physics (especially mechanics), and vector mathematics.

COURSE OBJECTIVES:

1. To Learn the use scalar and vector analytical techniques for analyzing forces in Statically determinate structures.
2. To introduce the equilibrium of rigid bodies.
3. To study and understand the distributed forces, surface, loading on beam and intensity.
4. To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. To develop basic dynamics concepts – force, momentum, work and energy.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Illustrate the vectorial and scalar representation of forces and moments

CO2: Analyze the rigid body in equilibrium

CO3: Evaluate the center of Gravity and Moment of Inertia of an object

CO4: Calculate dynamic forces exerted in rigid body

CO5: Determine the friction and the effects by the laws of friction

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	1	-	-	-	-	-	-	2	3	3	2
2	3	3	3	2	2	-	-	-	-	-	-	2	3	3	2
3	3	3	2	1	1	-	-	-	-	-	-	1	3	3	2
4	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
5	3	3	3	2	2	-	-	-	-	-	-	2	3	3	2
Avg.	3	3	3	2	2	-	-	-	-	-	-	2	3	3	2

UNIT 1 STATICS OF PARTICLES **09**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces (Statement Only) – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Equivalent systems of forces – Principle of transmissibility.

UNIT 2 **EQUILIBRIUM OF RIGID BODIES** **09**

Free body diagram – Types of supports –Action and reaction forces (Beam only) – stable equilibrium – Conditions of equilibrium - Moments and Couples – Moment of a force about a point and about an axis.

UNIT 3 **PROPERTIES OF SURFACES AND SOLIDS** **09**

Centroids and centre of mass – Centroids sections - Rectangle, Circle, Triangle – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus (Statement Only) - Area moments of inertia of plane areas – Rectangle, Circle, Triangle, T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem (Statement Only) – Polar Moment of Inertia – Radius of Gyration.

UNIT 4 **DYNAMICS OF PARTICLES** **09**

Introduction – Dynamics - Kinematics & Kinetics – Characteristics of Kinematics - Displacements, Velocity and acceleration, their relationship - Newton's laws of motion – Work Energy Equation– Impulse and Momentum.

UNIT 5 **FRICTION** **09**

Friction – Types of friction – Limiting friction – Coulomb's law of dry friction – Impending Motion – Angle of Repose – Body on a Rough inclined plane – Simple Contact Friction – Ladder Friction – Screw Friction – Belt Friction.

TEXT BOOKS:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998
2. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

REFERENCE BOOKS:

1. R.S.Khurmi. "A Text Book of Engineering Mechanics, S Chand Publishing, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
3. P. JagetBabu, "Engineering Mechanics", Pearson Education, India Ltd, 2016
4. N.Kottiswaran, "Engineering Mechanics", Sri Balaji Publications, 2013.

U23GE202	**BASICS OF ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

PREREQUISITES:

Engineering Physics and Engineering Mathematics

COURSE OBJECTIVES:

1 Analyze the Electric Circuits.

2 Analyze the electric network using magnetic property and also acquire knowledge about electrical safety measures.

3 Explain the construction and operation of DC and AC Electrical machines

4 Explain the construction, operation and applications of special semiconductor devices and Design simple electronic circuits

5 Explain the operation of basic measuring instruments and transducers

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Analyze the electric circuits using circuit laws.

CO2: Interpret the properties of magnetic circuits and various methods in electrical installations and also about electrical safety measures.

CO3: Acquire the knowledge about the Construction and operation of DC and AC Electrical machines.

CO4: Design simple electronic circuits using semiconductor devices.

CO5: Summarize the operation of basic measuring instruments and transducers for Electrical and Electronic circuits.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	2	2	-	-	-	-	-	-	1	2	1	-
2	3	2	1	1	-	3	2	2	-	-	-	1	1	2	-
3	3	2	2	1	-	-	-	-	-	-	-	2	2	3	1
4	2	2	3	3	3	-	-	-	1	1	-	2	2	3	2
5	3	3	2	2	3	-	-	-	-	2	-	2	2	2	3
Avg.	2.8	2.4	1.8	1.8	2.6	3	2	2	1	1.5	-	1.6	1.8	2.2	2

UNIT 1 **ELECTRICAL CIRCUITS** **12**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems

UNIT 2 **MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS** **06**

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.

Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

UNIT 3 **ELECTRICAL MACHINES** **09**

Construction, Working Principle and applications of DC generators, DC Motors, single phase Transformers, three phase and single-phase induction motors.

UNIT 4 **SEMICONDUCTOR DEVICES AND CIRCUITS** **09**

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters.

UNIT 5 **SENSORS AND TRANSDUCERS** **09**

Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

TEXT BOOKS:

1. Sudhakar A. and Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis", 5th Edition, McGraw-Hill Education, New Delhi, 2017
2. .Kalsi .H.S," Electronics Instrumentation" 3 rd Edition (copyright 2010,Second Reprint 2011) Tata McGraw Hill, New Delhi, 2010.
3. Electronic Devices and Circuits by S Salivahanan (Author), N. Suresh Kumar (Author)-5th Edition-2022

REFERENCE BOOKS:

1. Hayt W.H., Kemmerly J.E., Durbin S.M., "Engineering Circuit Analysis", 9th Edition, Tata McGraw-Hill, New Delhi, 2020.
2. Sawhney.A.K, "A course in Electrical and Electronic measurement and Instrumentation", Dhanpat Rai & Sons New Delhi, 18 th Edition 2001.
3. Anil K Maini, Varsha Agarwal, " Electronic Devices and Circuits", Wiley India Private Ltd., New Delhi 1stEdition 2015

Web References:

1. http://nptel.cG.in/video.php?subjectId=117103063
2. http://nptel.ac.in/video.php?subjectId=122106025
3. http://nptel.ac.in/courses/108108076

LABORATORY COMPONENT CONTENT:

List of Experiments

1. (a)Verification of Kirchoff's Voltage and Current Laws.
   (b)Verification of series and parallel circuits.
2. Study of three phase power system.
3. Load test on DC shunt motor.
4. Load characteristics of DC generator.
5. Load test on single phase transformer.
6. Load test on single phase induction motor.
7. Study of electrical safety measures.
8. Characteristics of PN junction diode and Zener diode.
9. Characteristics of CE configuration.

		L	T	P	C
U23EN202	**PROFICIENCY IN ENGLISH**	**2**	**0**	**2**	**3**

PRE-REQUISITES:

BASIC GRAMMAR AND COMMUNICATION STRATEGIES

COURSE OBJECTIVES:

1	To engage learners in meaningful language activities to improve their LSRW skills.
2	To identify personality traits and evolve as a better team player
3	To develop analytical thinking skills for problem solving in communicative contexts
4	To demonstrate an understanding of job applications and interviews for internship andplacements
5	To identify varied group discussion skills and apply them to take part in effective discussions in a professional context

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1:	Identify causes and effects in events, and industrial processes through technical text
CO2:	Understand and use tools of structured written communication
CO3:	Identify individual personality types and roles in a team
CO4:	Understand the basic concepts of morality and diversity
CO5:	Present their opinion in a planned and logical manner, and draft effective resumes in the context of job search

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	-	3	1	-	2	-	-	-
2	-	-	-	-	-	1	1	-	3	2	-	2	-	-	-
3	-	-	-	-	-	2	2	-	3	2	-	3	-	-	-
4	-	-	-	-	-	2	2	-	3	1	-	2	-	-	-
5	-	-	-	-	-	1	2	-	3	3	-	3	-	-	-
Avg.	-	-	-	-	-	1.4	1.6	-	3	1.8	-	2.4	-	-	-

UNIT 1 **MAKING COMPARISONS** **09**

Listening – Listening to informal conversations (Activity)
Speaking – Role Play - talking about experiences- talking about events in life- discussing past events Reading - Reading advertisements, Extensive Reading (Activity) Writing – Reading Comprehension, Writing a review/ summary of story/article. Grammar – Active voice & Passive voice, Prepositional phrases

UNIT 2 **EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING** **09**

Listening - Listening to longer technical speech, listening to situation-based dialogues Speaking – discussing news stories -talking about travel problems and procedures Reading - Reading longer technical texts, reading a short story Writing - Personal letter (Inviting your friend), Congratulating letter, Writing responses to complaints and adjustment letter Grammar - Infinitive and Gerunds, Modals

UNIT 3 **PROBLEM SOLVING** **09**

Listening – Listening to movie scenes/ documentaries depicting a technical problem and suggesting solutions (Activity). Speaking – Conversation skills with a sense of stress, intonation, pronunciation, Welcome address - vote of thanks. Reading - Case Studies, news reports, reading passages with time limit. Writing – Letter to the Editor, Short report on an event (field trip). Grammar -– If conditional sentence, Phrasal Verbs

UNIT 4 **REPORTING OF EVENTS AND RESEARCH** **09**

Listening – Listening Comprehension based on news reports Speaking – Presenting an oral report, talking about past, present and the future (Activity) Reading – Newspaper articles; Reading the job advertisements and the profile of the company Writing – Essay writing and its types (Compare & Contrast, Cause & Effect, Problem & Solution) Grammar – Reported Speech, Conjunctions

UNIT 5 **THE ABILITY TO PUT IDEAS OR INFORMATION TO COGENTLY** **09**

Listening – Listening to Presentations Speaking – Participating in a Role, talking about environmental issues, Talking about everyday services (Activity) Reading – Note making skills – making notes from books Writing – Email Writing, Biographical sketches of famous personalities Grammar – Relative Clauses, Collocation, Fixed &

Semi-fixed expressions

TEXT BOOKS:

1 English for Engineers & Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020
2 Barun.K.Mithra, Personality Development and Soft Skills, OUP India, 2019

REFERENCE BOOKS:

1 Jack C. Richards, "Interchange, Student's Book", 4th Edition, Cambridge University Press, New York, 2017.
2 Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi
3 Muralikrishna & Sunitha Mishra, Communication Skills for Engineers and Scientists, PH Learning, new Delhi, 2009.
4 Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd.1990, Delhi.
5 Shalini Varma, "Development of Life Skills and Professional Practice", 1st Edition, Vikas Publishing House Pvt. Ltd., 2014

U23GE203	**PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
		2	0	2	3

COURSE OBJECTIVES:

1 To understand and develop programs using Python.
2 To use the concepts of strings, control flow, data types in python programs.
3 To create programs using list, tuples, dictionaries, and files concept in Python.
4 To analyze image processing, networking and object-oriented programming in Python.
5 To create new ideas for problems in real world application using python.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Explain the concepts of Python.
CO2: Use appropriate constructs to represent data
CO3: Analyze programs using different constructs in Python
CO4: Develop real world applications using GIS and Spatial Analysis
CO5: Apply simple programs for real world application using IOT and Sensor in python

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	-	2	-	-	-	-	-	-	1	2	1	-
2	2	3	1	2	2	-	-	-	-	-	-	1	2	2	1
3	2	3	2	3	3	-	-	-	1	-	-	2	2	2	2
4	1	2	3	3	3	1	1	-	2	2	2	3	3	3	3
5	2	2	3	3	3	2	1	1	2	2	2	3	3	2	3
Avg.	2	2.2	2.3	2.8	2.7	1.5	1	1	1.7	2	2	2	2.4	2	2.3

UNIT 1 **INTRODUCTION TO PYTHON PROGRAMMING** **06**

Introduction to Computer and its generations-Basics of Programming languages-Overview of Python- Python Interpreter and Interactive Mode -Variables-Numerical types- Arithmetic operators and Expressions- Psuedo Code - Values and types: int, float, Boolean - Variables, Expressions, Statements.

UNIT 2 **DATA TYPES, CONTROL FLOW, STRINGS** **06**

Control Flow -conditional (if), Alternative (if-else), Chained conditional (if-else)- Iteration: state, while, for, break, continue, pass - Strings: string slices, immutability, string functions and methods, string module, Regular expression, Pattern matching. - Illustrative Problems.

UNIT 3 **LISTS, TUPLES DICTIONARIES AND FUNCTIONS** **06**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters- Tuples: tuple assignment, tuple as return value- Dictionaries: operations and methods- Functions and User Defined Functions, Recursion - Illustrative Problems

UNIT 4 **FILES AND GIS AND SPATIAL ANALYSIS CONCEPT IN PYTHON** **06**

Files, Text files, reading and writing files-format operator; Files and exception handling - Introduction to Geographic Information Systems (GIS) and spatial data - Working with GeoPandas: Manipulating and analyzing geospatial data.

UNIT 5 **IOT AND SENSOR DATA PROCESSING USING PYTHON** **06**

Internet of Things (IoT) in agriculture: Sensors, data collection, and communication protocols. Processing sensor data: Filtering, smoothing, and analyzing time-series data-Applying Python programming skills to solve real-world agricultural engineering problems.

TEXT BOOKS:

1 Python Programming for Beginners: Skyrocket Your Code and Master Python in Less than a Week. Discover the Foolproof, Practical Route to Uncover Insider Hacks, Unlock New Opportunities, and Revolution Kindle Edition by Kit Jackson (Author)
2 Introducing Python, 2nd Edition, by Bill Lubanovic, O'Reilly Media, Inc., 2019

S. NO	LIST OF EXPERIMENTS
1	Simple programs to execute the concept of python for editing, saving and handling error message.
2	Python program using Statements and Expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3	Scientific problems using Conditionals and Iterative loops (Number series, Number patterns, pyramid pattern).
4	Programs for functions using python (Factorial, larger number in a list).
5	Implementing programs using regular expressions.
6	Program for implementing strings (reverse, palindrome).
7	Implementing real time application using List, Tuples (Items present in library, operations of list and tuples).
8	Python programs for real time using file handling (Coping from one file to another, word count, longest word)
9	Python program using gis and spatial analysis
10	Python program using IOT and sensor data processing
11	Mini Project

REFERENCE BOOKS:

1 Python Programming for Beginners, ISBN-13-979-8870875248, Narry Prince, 2023
2 Python Programming, West McKinney, ISBN-13-979-8870534817,2023
3 Python Quick Start Guide: The Simplified Beginner's Guide to Python Programming Using Hands-On Projects and Real-World Applications, by Robert Oliver, ISBN-13-978-163610037, 2023.
4 Mastering Python Networking: Utilize Python packages and frameworks for network automation, monitoring, cloud, and management by Eric Chou,2023

U23AG201	AGRONOMY AND LIVESTOCK MANAGEMENT	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:

1 To introduce the students about the basic principles of Agronomy
2 Understand the basic concepts of tillage and irrigation
3 To delineate the role of Livestock management and basics of Poultry Management Practices in Agriculture
4 To introduce the production practices of agricultural and horticultural crops
5 To delineate the role of agricultural engineers in relation to various crop production Practices.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Acquire knowledge on the basic principles of Agronomy

CO2: Know the basic concepts of tillage and irrigation

CO3: Know about the basic package of practices Agricultural & Horticultural Crops

CO4: Have the required knowledge in the area of Livestock management

CO5: Know the basic concepts of Poultry Management

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	3	2	1	3	3	3	3	3	-	1	2	3	2	3
2	3	2	2	3	3	2	3	3	3	-	2	1	3	2	-
3	3	2	1	1	2	1	1	2	3	-	1	1	1	-	-
4	3	-	3	2	2	2	2	3	3	-	2	3	-	2	3
5	3	1	2	3	1	2	3	3	3	-	1	1	3	1	3
Avg.	**2.4**	**1.6**	**2**	**2**	**2.2**	**2**	**2.4**	**2.8**	**3**	**-**	**1.4**	**1.6**	**2**	**1.4**	**1.8**

UNIT 1 **Agronomy and its scope** **09**

Agronomy – definition – meaning and scope. Crops and major soils - Classification – Economic and agricultural importance in India and Tamil Nadu - Factors affecting crop production – climatic – edaphic - biotic- physiographic and socio-economic factors

UNIT 2 **Tillage and irrigation** **09**

Tillage – Definition – objectives – types of tillage - modern concepts of tillage – main field preparation-Seeds - Seed rate - Sowing methods - Germination - Crop stand establishment - Inter cultivation - Intercultural operations - Irrigation - Time and methods - Modern techniques of irrigation & drainage - its importance - Cropping pattern and cropping system - Intensive cropping

UNIT 3 **Fundamentals of Livestock & Poultry Management** **09**

Role of livestock in the national economy - Important breeds of cattle and buffalo - housing of dairy cattle and buffaloes - conventional barns or stanchion barn- floor space requirements- feeding and watering space requirements- ear tagging- branding- ear notching - important guidelines in young calf rearing/milk feeding.

S.NO **LIST OF EXPERIMENTS**

1. Land preparation and configuration
2. Selection of seeds and practicing seed treatment
3. Seed bed and nursery preparation
4. Sowing and Planting
5. Nutrition Management studies
6. Water management and irrigation scheduling
7. Weed management studies
8. Integrated pest management studies
9. Maturity and harvesting

TEXT BOOKS:

1 Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.
2 Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 2005.
3 A Textbook of Animal Husbandry – G.C. Benerjee
4 Livestock Production and Management – N.S.R. Sastri, C.K. Thomas, R.A. Singh

REFERENCE BOOKS:

1 Essentials of Animal Production and Management – R. Singh
2 A Handbook of Animal Husbandry – ICAR
3 A Textbook of Livestock Production Management in Tropics – D.N. Verma Bose T. K. and L.P.Yadav. Commercial Flowers, Naya Prakash, Calcutta.1989.
4 Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005
5 Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil. 1993.
6 Kumar, N.," Introduction to Horticulture", Rajalakshmi Publications. Nagercoil, 7 edition, 2015.
7 Shanmugavel, K.G. Production Technology of Vegetable Crops. Oxford India Publications, New Delhi. 1989.

SEMESTER III

UG23AG301 **FLUID MECHANICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1 To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
2 To expose to the applications of the conservation laws to flow measurements.
3 To expose to the applications of the conservation laws to flow through pipes and to understand the importance of dimensional analysis.
4 To understand the importance of various types of flow in pumps.
5 To understand the importance of various types of flow in turbines.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recognize the properties of fluids, pumps and turbines
CO2: Understanding the concepts of fluid kinematics, pumps and turbines
CO3: Apply fluids laws to pressure and flow measurements
CO4: Apply principles of fluid laws to design pump, turbines and prototypes
CO5: Analyze the concepts of fluid kinematics in real life problems

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	-	-	-	-	-	-	-	-	1	2	1	-
2	3	2	-	-	-	1	-	-	-	-	-	1	2	2	1
3	2	3	1	2	1	-	-	-	1	-	-	2	3	2	1
4	2	2	3	3	2	1	1	-	2	1	2	2	2	3	2
5	2	3	2	2	1	2	2	1	2	2	2	3	3	2	3
Avg.	2.4	2.2	2	2.3	1.3	1.3	1.5	1	1.8	1.5	2	1.8	2.4	2	1.8

UNIT 1 **PROPERTIES OF FLUIDS** **09**

Properties of fluids – definition – units of measurement -Mass density – specific weight, specific volume – specific gravity-Viscosity-Kinematic viscosity- Newton's law of viscosity-Types of Fluids-Compressibility and Bulk modulus- Surface Tension and capillarity – Pressure and its measurement – Fluid pressure at a point – Pascal's Law (Statement only) –Absolute, Gauge, Atmospheric and Vaccum Pressure – Simple Manometers – Simple Problems.

UNIT 2 **FLUID FLOW** **09**

Types of fluid flow-Rate of flow or Discharge-Continuity Equation in Cartesian Coordinates – Velocity and Acceleration – Velocity Potential function - Stream function – Equipotential line – Flow net –Dynamics of Fluid Flow – Euler's

Equations of motion – Bernoulli's Equations from Euler's Equations – Assumptions – Bernoulli's Equations for Real fluid – Practical Applications of Bernoulli's Equations – Venturimeter – Orificemeter – Simple problems.

UNIT 3 FLOW THROUGH PIPES & DIMENSIONAL ANALYSIS 09

Flow through pipes – laminar and turbulent flow in pipes - Darcy – Weisbach equation for friction head loss – Chezy's formula - Major and minor losses in pipes – Simple problems - Dimension and units: Buckingham's Π theorem.

UNIT 4 PUMPS 09

Centrifugal Pump – Main parts of a centrifugal pump – Workdone by the centrifugal pump on water – Definitions of Head and Efficiencies of a centrifugal pump – Simple Problems – Specific speed of a centrifugal pump – Reciprocating Pump - Main parts, Working and Classification of Reciprocating Pump (Descriptive only) – Comparison of Centrifugal pump and Reciprocating Pump.

UNIT 5 TURBINES 09

Introduction – Definitions of Head and Efficiencies of a Turbine – Classification of Hydraulic Turbines – Pelton Wheel – Working Principle – Velocity Triangles and work done for Pelton wheel – Simple Problems – Francis Turbine – Important relations for Francis Turbine – Simple Problems – Kaplan Turbine (Descriptive only).

TEXT BOOKS:

1 Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.
2 Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

REFERENCE BOOKS:

1 Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016.
2 Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
3 Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
4 Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

UG23AG302	SURVEYING AND LEVELING FOR AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1 To introduce rudiments of plane surveying and geodetic principles to agricultural engineers.
2 To learn various methods of plane and geodetic surveying to solve real world problems

3 To introduce concepts of contour surveying

4 To understand the concepts of Theodolite survey in linear and angular measurements

5 To introduce the basics of modern surveying methods

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify and explain basic surveying principles, terminology, instruments, errors and methods used in chain, compass, levelling, contouring and modern survey

CO2: Explain surveying procedures, adjustments, bearing systems, contour characteristics and measurement techniques used in different surveying methods

CO3: Apply chain, compass, levelling, contouring and tacheometric methods to determine distances, elevations, areas and volumes.

CO4: Apply surveying data to compute areas, volumes, heights, contours and traverse results with error considerations.

CO5: Analyze integrated surveying problems using conventional and modern surveying techniques for practical field applications

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	-	1	-	-	-	1	-	-	1	2	1	-
2	3	1	-	-	1	1	-	-	1	-	-	1	2	2	1
3	2	3	1	2	2	1	-	-	2	-	1	2	3	2	1
4	2	3	2	3	2	1	-	-	2	2	2	2	3	3	2
5	2	3	3	3	3	2	1	1	2	2	2	3	3	3	3
Avg.	2.4	2.5	2	2.7	1.8	1.3	1	1	1.6	2	1.7	1.8	2.6	2.2	1.8

UNIT 1 FUNDAMENTALS AND CHAIN SURVEYING 09

Definition- Classifications - Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging - well conditioned triangles - computation of cross-sectional areas (Simpon's rule and Trapezoidal rule)- – Chain traversing

UNIT 2 COMPASS AND PLANE TABLE SURVEYING 09

Compass – Basic principles - Types - Bearing -systems and conversions – Sources of Errors - Local attraction – magnetic declination- Dip -compass traversing – Plane table and its accessories – Merits and demerits – Radiation – Intersection – Resection – Plane table traversing

UNIT 3 **LEVELLING** **09**

Level line – Horizontal line – Datum – Benchmarks – Levels and staves – Temporary and permanent adjustments – Methods of leveling – Fly leveling – Check leveling – Procedure in leveling – Booking – Reduction – Curvature and refraction – Reciprocal leveling – Precise leveling - Contouring.

UNIT 4 **CONTOURING** **09**

Contouring - Methods – Characteristics and uses of contours - Plotting – Methods of interpolating contours – Earthwork calculations - Capacity of reservoirs - Mass haul diagrams. Grid Contouring.

UNIT 5 **THEODOLITE AND MODERN SURVEYING** **09**

Horizontal and vertical angle measurements – Temporary and permanent adjustments – Heights and distances – Tacheometric surveying – Stadia Tacheometry – Tangential Tacheometry – Trigonometric leveling – Single Plane method – Double Plane method. Modern surveying methods : Total Station: Digital Theodolite, EDM, Electronic field book – Advantages- Applications

TEXT BOOKS:

1 Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd., New Delhi, Sixteenth Edition, 2016
2 T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008

REFERENCE BOOKS:

1 R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012
2 James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
3 Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4 S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India2010
5 K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013
6 C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

U23MA308 **OPTIMIZATION TECHNIQUES** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

1 To understand the formulation and solving linear programming problems.
2 To develop formulation skills in transportation models in engineering fields.
3 To find the most efficient allocation of limited resources to competing tasks.
4 To apply network models such as CPM and PERT in project management.
5 To analyze decision-making situations using game theory techniques

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: **Demonstrate a thorough understanding of fundamental concepts in linear programming, transportation and assignment problems, networking, and game theory.**

CO2: Apply the MODI method to find optimal solutions for transportation and assignment problems and solve game theory problems using both algebraic and graphical techniques.

CO3: Apply game theory concepts to solve two-person zero-sum games using dominance, graphical methods, and approximate solutions to develop optimal strategies.

CO4: Analyze project networks using PERT and CPM, to calculate project timelines, floats, and handle uncertainty in project scheduling

CO5: Formulate mathematical models for optimization problems such as linear programming, transportation, assignment, and network scheduling

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	-	-	-	-	-	-	-	-	1	2	1	-
2	3	1	-	-	-	-	-	-	-	-	1	1	2	1	-
3	2	3	1	1	-	-	-	-	1	-	2	2	2	2	1
4	2	3	2	2	1	-	-	-	1	1	2	2	2	2	2
5	2	3	3	2	2	1	1	-	2	2	3	3	3	3	3
Avg.	2.4	2.2	2	1.7	1.5	1	1	-	1.3	1.7	2	1.8	2.2	1.8	2

UNIT 1 LINEAR PROGRAMMING 09

Formulation of Linear Programming Problems - Graphical solution to Linear Programming Problems - Simplex Method –Big M method- Duality in Linear programming

UNIT 2 TRANSPORTATION PROBLEMS 09

Transportation Problem - Initial basic feasible solutions using North-West Corner Rule, Least Cost method and Vogel's approximation method - Optimality in Transportation Problem – MODI Method

UNIT 3 ASSIGNMENT PROBLEMS 09

Assignment Algorithm – Hungarian Method for Optimal assignments – Alternative Optimal Solutions – Maximization Problem – Unbalanced assignment problems - Travelling Salesman Problem.

UNIT 4 NETWORKING PROBLEMS 09

Network Models - Uncertainty of PERT and CPM – Early Start, Early Finish, Late Start and Late Finish – Total float, Free float and independent float.

UNIT 5	**GAME THEORY**	**09**

Introduction to Game theory, Two person zero sum Game, Game with dominance, Approximate solution for Games, Graphical method of solving Games.

TEXT BOOKS:

1 Gupta, P.K., and Hira, D.S., Operations Research, 3rd Edition, S. Chand & Company Ltd., New Delhi, 2014.
2 Taha, Hamdy A., Operations Research: An Introduction, 10th Edition, Pearson Education, New Delhi, 2017.
3 Panneerselvam, R., Operations Research, 2nd Edition, Prentice Hall of India, New Delhi, 2006.

REFERENCE BOOKS:

1 Swarup, Kanti., Gupta, P.K., and Man Mohan, Operations Research, 20th Edition, Sultan Chand & Sons, New Delhi, 2020.
2 Hillier, F.S., and Lieberman, G.J., Introduction to Operations Research, 10th Edition, McGraw Hill Education, New Delhi, 2015.
3 Vohra, N.D., Quantitative Techniques in Management, 4th Edition, Tata McGraw Hill, New Delhi, 2017
4 Operations Research - H.A.Taha, Pearson, 7th Edition, June 2002.
5 Veerarajan, T, "Probability, Statistics, Random Processes and Queuing Theory", 1st Edition, Tata McGraw-Hill, New Delhi, 2019
6 Operations Research - Theory and Applications, J.K Sharma, Macmillan Publications India Ltd, 2013

		L	T	P	C
U23AG2O2	**SOIL SCIENCE AND ENGINEERING**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

1 To provide acquaintance with differently peso frocks, their characteristics, soil forming process, varied soil properties and various techniques to measure them.
2 To introduce soil taxonomy, land capability classification and reclamation measures for problem soils.
3 To understand soil phase relationship and compaction.
4 To analyze engineering properties of soil.
5 To get acquainted with bearing capacity of soil and slope stability.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall basic soil properties, classification terms, and core concepts of strength, permeability, bearing capacity, and slope stability.

CO2: Explain soil formation, soil–water behavior, classification principles, land capability, and fundamental soil mechanics concepts.

CO3: Apply soil survey methods, engineering classification tests, phase relations, compaction and permeability procedures, and basic bearing capacity calculations.

CO4: Evaluate soil properties, laboratory/field test data, land capability, compaction quality, permeability, and foundation suitability.

CO5: Analyze soil behavior, failure mechanisms, seepage, bearing capacity, and slope stability using analytical methods.

CO6: Recall basic soil properties, classification terms, and core concepts of strength, permeability, bearing capacity, and slope stability.

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	1	2	1	-
2	3	1	-	-	-	1	1	-	-	-	-	1	2	2	1
3	2	3	1	2	1	-	-	-	2	-	1	2	3	2	1
4	2	3	2	3	2	1	1	-	2	2	2	2	3	3	2
5	2	3	3	3	2	2	2	1	2	2	2	3	3	2	3
Avg.	2.4	2.5	2	2.7	1.7	1.3	1.3	1	2	2	1.8	1.8	2.6	2	1.8

UNIT 1 **INTRODUCTION AND SOIL PHYSICS** **06**

Soil - definition - major components –Soil forming minerals and processes - soil profile -Physical properties. Movement of soil water. Soil colloids – organic and inorganic matter-Ion exchange- pH – Plant nutrient availability

UNIT 2 **SOIL CLASSIFICATION AND SURVEY** **06**

Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey – Field mapping- mapping units - base maps – preparation of survey reports-concepts and uses-Land Capability Classes and subclasses-soil suitability-Problem soils–Reclamation.

UNIT 3 **PHASE RELATIONSHIP AND SOIL COMPACTION** **06**

Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction.

UNIT 4 **ENGINEERING PROPERTIES OF SOIL** **06**

Shear strength of cohesive and cohesionless -Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test- - Permeability-Coefficient of Permeability-Darcy's law - field and lab methods- Assessment of seepage-Compressibility.

UNIT 5 **BEARING CAPACITY AND SLOPE STABILITY** **06**

Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow

foundations-Terzaghi's formula- BIS standards - Slope Stability- Analysis of infinite and finite slopes- friction circle method- slope protection measures.

S.NO	LIST OF EXPERIMENTS
1	Identification of rocks and minerals
2	Collection and processing of soil samples
3	Determination of soil moisture, EC and pH
4	Field density determination by Core Cutter method
5	Field density determination by Sand Replacement method
6	Specific gravity determination by Pycno meter
7	Grainsize analysis by using Mechanical shaker
8	Determination of soil compaction using standard proctor test
9	Determination of plastic limit of soil
10	Determination of liquid limit of soil

TEXT BOOKS:

1 Nyle C. Brady, "The Nature and Properties of Soil", Macmillan Publishing Company, 10th Edition, New York, 2008.

2 Punmia, B.C., "Soil Mechanics and Foundation "Laxmi Publishers, New Delhi, 2007.

REFERENCE BOOKS:

1 Edward J.Plaster., "Soil Science", Cengage Learning India Ltd, New Delhi, 2009

2 Arora,K.R. "Soil Mechanics and Foundation Engineering", standard publishers and distributors, New Delhi, 2007

3 Murthy. V.N.S., "Soil Mechanics and Foundation Engineering", UBS Publishers and Distributors, New Delhi, 2007

4 Sehgal,S.B., "Text Book of Soil Mechanics", CBS Publishers and Distributors NewDelhi,2007.

U23AG303	THEORY OF MACHINES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

1 To understand the basic components and layout of linkages in the assembly of a system machine.

2 To study the basic concepts of toothed gearing and kinematics of gear trains.

3 To design cam mechanisms for specified output motions.

4 To understand the effect of Dynamics of undesirable vibrations.

5 To understand the principles in mechanisms used for speed control and stability control.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify and explain basic concepts of mechanisms, gears, cams, vibrations and governors.

CO2: Explain kinematic relationships, governing principles and operating characteristics of machine elements.

CO3: Apply kinematic and dynamic principles to solve problems related to mechanisms, gears, cams, vibrations and governors

CO4: Analyze machine elements to evaluate motion, speed ratios, vibrations and governing performance

CO5: Analyze integrated mechanical systems involving mechanisms, gears, cams, vibrations and governors.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	-	-	-	-	-	-	-	-	1	2	1	-
2	3	2	-	-	-	1	-	-	-	-	-	1	2	2	1
3	2	3	2	2	1	-	-	-	1	-	-	2	3	2	1
4	2	3	3	3	2	1	1	-	2	1	2	2	2	3	2
5	1	3	3	3	2	2	2	1	2	2	2	3	3	2	3
Avg.	2.2	2.4	2.7	2.7	1.7	1.3	1.3	1	1.8	1.5	2	1.8	2.4	2	1.8

UNIT 1 **BASICS OF MECHANISMS** **06**

Introduction - Kinematic Link or Element - Kinematic Pair - Kinematic Chain - Mechanism– Degree of freedom, Mobility – Kutzbach criterion, Grubler's criterion – Grashof's Law – Kinematic inversions of four-bar chain, single slider crank chain and double slider crank mechanism.

UNIT 2 **GEARS AND GEAR TRAINS** **06**

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio. Gear trains – Speed ratio, train value – Epicyclic Gear Trains (simple problems).

UNIT 3 **KINEMATICS OF CAM MECHANISMS** **06**

Classification of cams and followers - Terms Used in Radial Cams - Motion of the Follower - Displacement, Velocity and Acceleration Diagrams when the follower moves with Uniform Velocity, Simple Harmonic Motion and Uniform Acceleration and Retardation.

UNIT 4 **LONGITUDINAL AND TRANSVERSE VIBRATIONS** **06**

Types of Vibratory Motion -Types of Free Vibrations - Natural Frequency of Free Longitudinal Vibrations - Equations of motion- -Types of damping-Damped free

vibration - Natural Frequency of Free Transverse Vibrations- Critical or Whirling Speed of a Shaft

UNIT 5 **GOVERNOR** **06**

Function of a Governor - Types of Governors –Terms used in governors Centrifugal Governor - Watt Governor - Porter Governor – Proell Governor - Sensitiveness of Governors - Effort and Power of a Governor - Simple problems.

S.NO	LIST OF EXPERIMENTS
1	Study of gear parameters
2	Kinematics of Four Bar, Slider Crank and Oscillating cylinder Mechanisms.
3	Kinematics of Crank Rocker, Double crank, Double rocker Mechanisms.
4	Cam Analysis
5	Determination of Natural frequency using compound pendulum method.
6	Transverse Vibration – Cantilever Beam
7	Transverse Vibration – Simply supported Beam
8	Experiment on Watts Governor

TEXT BOOKS:

1 Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 2014.
2 R.S. Khurmi, J K Gupta, “Theory of Machines”, S.Chand Publications., 2015.

REFERENCE BOOKS:

1 Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017.
2 Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 3rd edition 2019.
3 Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
4 Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014.
5 Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

U23AG311 **FLUID MECHANICS LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

1 Enrich the concept of fluid mechanics and hydraulic machines.
2 Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
3 Correlate various flow measuring devices such as Venturimeter, orifice meter and notches etc
4 Discuss the performance characteristics of turbines and pumps

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Apply Bernoulli equation for calibration of flow measuring devices

CO2: Measure friction factor in pipes and compare with moody diagram

CO3: Determine the performance characteristics of rotodynamic pumps

CO4: Determine the performance characteristics of positive displacement pumps

CO5: Conduct experiments, analyze data and interpret results to validate theoretical Concepts in fluid mechanics

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	-	2	1	-	-	-	2	-	-	1	2	1	-
2	2	3	-	2	1	-	-	-	2	-	-	1	2	1	-
3	1	3	2	3	2	-	-	-	3	1	1	2	2	3	2
4	1	3	2	3	2	-	-	-	3	1	1	2	2	3	2
5	2	3	2	3	2	1	1	1	3	2	2	3	3	2	3
Avg.	1.6	3	2	2.6	1.6	1	1	1	2.6	1.3	1.3	1.8	2.2	2	2.3

S.NO	LIST OF EXPERIMENTS
1	Determination of the Coefficient of discharge of given Orifice meter.
2	Determination of the Coefficient of discharge of given Venturi meter.
3	Calculation of the rate of flow using Rota meter.
4	Determination of friction factor for a given set of pipes.
5	Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump.
6	Conducting experiments and drawing the characteristic curves of reciprocating pump.
7	Conducting experiments and drawing the characteristic curves of Gear pump.
8	Conducting experiments and drawing the characteristic curves of Pelton wheel.
9	Conducting experiments and drawing the characteristics curves of Francis turbine.
10	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

U23AG312	**SURVEYING AND LEVELING LABORATORY FOR AGRICULTURAL ENGINEERING**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

1 At the end of the course the student will possess knowledge about survey field techniques.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Impart knowledge on the usage of basic surveying instruments like chain/tape, compass and levelling instruments.
CO2: Apply levelling instrument for surveying operations.
CO3: Apply theodolite for various surveying operations.
CO4: Carryout necessary surveys for social infrastructures.
CO5: Prepare planimetric maps.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	2	2	-	-	-	2	2	-	1	2	1	-
2	2	3	1	3	2	-	-	-	3	2	1	2	3	2	2
3	2	3	1	3	2	-	-	-	3	2	1	2	3	2	2
4	2	3	2	3	2	2	2	1	3	3	2	2	2	2	3
5	1	3	3	3	3	1	1	1	3	3	2	3	2	3	3
Avg.	2	2.6	1.8	2.8	2.2	1.5	1.5	1	2.8	2.4	1.5	2	2.4	2	2.5

S.NO	LIST OF EXPERIMENTS
1	Aligning, Ranging and Chaining
2	Computation of area of the plot using Chain traversing
3	Compass Traversing – Measuring Bearings & arriving included angles
4	Fly leveling using Dumpy Level (Height of Instrument and Rise & Fall method)
5	Measurements of horizontal angles by reiteration and repetition and vertical angles
6	Determination of elevation of an object using single plane method when base is Accessible/inaccessible.
7	Determination of Tacheometric Constants
8	Heights and distances by stadia Tacheometry and Tangential Tacheometry
9	Computation of area of an agricultural farmland using Total Station
10	Using Global Positioning System (GPS) Technology for Tree marking in an agricultural farmland

TEXT BOOKS:

1 Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd., New Delhi, Sixteenth Edition, 2016
2 T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008

REFERENCE BOOKS:

1 R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012
2 James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
3 Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4 S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India2010
5 K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013
6 C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

SEMESTER IV

U23AG401 THERMODYNAMICS AND HEAT TRANSFER

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Gain a fundamental understanding of various physical quantities relevant to thermodynamics.
2. Acquire knowledge about the application of the zeroth, first, and second laws of thermodynamics.
3. Comprehend the principles of operation in different refrigeration systems and determine various psychrometric properties.
4. Learn the mechanisms of heat transfer under steady-state and transient conditions.
5. Understand the fundamental concepts and principles of convective and radiative heat transfer.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Understand the fundamental concepts of thermodynamics, including the zeroth, first, and second laws, along with the working principles of refrigeration systems, psychrometry, and heat transfer.

CO2: Apply the zeroth, first, and second laws of thermodynamics by formulating temperature scales and calculating property changes in closed and open systems, as well as in various thermal applications.

CO3: Apply heat conduction equations to different geometries under steady-state conditions and solve problems related to thermal resistance and heat dissipation.

CO4: Analyze the properties of moist air and its application in psychrometric processes for air conditioning and refrigeration systems.

CO5: Analyze convective heat transfer in external flows over different surfaces and apply radiation heat transfer principles to evaluate energy exchange between surfaces.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	2	-	2	1	2	1	1
2	2	2	-	-	-	1	-	1	2	-	2	1	2	2	1
3	2	2	1	-	-	1	-	1	2	-	2	2	2	2	1
4	1	1	2	-	1	2	-	2	3	2	2	2	3	2	2
5	3	2	3	2	-	3	2	2	2	2	3	3	2	3	2
Avg.	2	1.6	2	2	1	1.6	2	1.6	2.2	2	2.2	1.8	2.2	2	1.4

UNIT 1 FIRST LAW OF THERMODYNAMICS **09**

Thermodynamic systems, Properties and processes, Thermodynamic Equilibrium- Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady flow processes.

UNIT 2 SECOND LAW AND ENTROPY **09**

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - Principle of increase in entropy (Descriptive only).

UNIT 3 REFRIGERATION AND AIR-CONDITIONING **09**

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – sensible heating and cooling, humidification, dehumidification and adiabatic mixing.
Refrigeration – Properties of Refrigerants -Construction and working principles of refrigeration, Vapour compression system – Vapour absorption- types, comparison (Descriptive only).

UNIT 4 CONDUCTION **09**

Modes of heat transfer, One-dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres (Without heat generation). Heat transfer in extended surfaces (Simple problems only).

UNIT 5 CONVECTION AND RADIATION **09**

Concepts of heat transfer by convection – Natural Convection (Descriptive only) - Forced convection – Problems in forced convection during external flow over flat Plates & Cylinders. Radiation heat transfer – Black body radiation, Emissivity, Stefan Boltzmann law, Plank's law, radiation between surfaces (Simple problems).

TEXT BOOKS:

1 Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2 Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
3 Holman, J. P., 'Heat Transfer ', 10th Edn., McGraw Hill, 2010.

REFERENCE BOOKS:

1 Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2 Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
3 Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.

4 Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi.
5 Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984

U23AG402 HYDROLOGY AND WATER RESORUCES ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To Gain basic knowledge of hydrological processes
2 To get acquainted with knowledge of hydrological extremes and groundwater
3 Understand about hydrological extremes like flood estimation and factors affecting it
4 Understand the underlying principles of storage reservoirs
5 Teach the fundamental concepts of groundwater management

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Describe hydrological processes, precipitation forms, runoff mechanisms, reservoirs and groundwater systems.
CO2: Interpret rainfall data, hydrographs, drought indices and reservoir characteristics.
CO3: Compute rainfall, runoff, flood peaks, storage capacity and groundwater recharge using standard hydrological methods.
CO4: Examine hydrological behaviour related to floods, droughts, reservoir operation and aquifer response.
CO5: Assess integrated surface and groundwater resources for sustainable water management planning.

CO-PO MAPPNG

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	1	2	-	-	-	-	1	2	1	-
2	2	2	-	1	-	-	1	-	2	1	-	1	2	2	1
3	3	3	2	2	1	-	-	-	2	1	2	2	3	2	1
4	2	3	2	3	1	2	2	1	2	2	2	2	2	3	2
5	2	2	3	2	2	3	3	2	2	2	3	3	2	3	3
Avg.	2.2	2.2	2.3	2	1.3	2	2	1.5	2	1.5	2.3	1.8	2.2	2.2	1.8

UNIT 1 PRECIPATION AND ABSTRACTIONS **09**

Hydrological cycle – Meteorological measurements – Types and forms of precipitation – Rain gauges – Spatial analysis of rainfall data using Theissen polygon and Iso-hyetal methods – Interception – Evaporation; Measurement, Evaporation suppression methods – Infiltration; Horton's equation – Double ring

infiltrometer – Infiltration indices

UNIT 2 RUNOFF **09**

Catchment; Definition, Morphological Characteristics – Factors affecting runoff – runoff estimation using Strange's table and empirical methods -SCS CN method – Stage discharge relationship -Flow measurements – Hydrograph – Unit Hydrograph - IUH

UNIT 3 HYDROLOGICAL EXTREMES **09**

Natural Disasters – frequency analysis – Flood estimation – Flood management – Definitions of drought; Meteorological, Hydrological Agricultural and Integrated – IMD method – NDVI analysis – Drought Prone Area Programme (DPAP)

UNIT 4 RESERVOIRS **09**

Classification of reservoirs – Site selection – General Principles of design -Spillways – Elevation -Area- Capacity Curve - Storage estimation -Life of reservoirs – Rule curve

UNIT 5 GROUNDWATER AND MANAGEMENT **09**

Origin – Classification and types – Properties of aquifers – Governing equations – Steady and unsteady flow Artificial recharge – RWH in rural and urban areas

TEXT BOOKS:

1 Subramanya K, "Engineering Hydrology" – Tata McGraw Hill, 2010
2 Jayarami Reddy P, "Hydrology", Tata McGraw Hill, 2008

REFERENCE BOOKS:

1 David Keith Todd., "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2 Ven Te Chow, Maidment, D R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998
3 Raghunath H M., "Hydrology", Wiley Eastern Ltd., 1998
4 Bhagu R Chahhar, Groundwater Hydrology, McGraw Hill Education (India)Pvt Ltd, New Delhi, 2007

U23AG403	**STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
2 To understand the concepts of stress, strain, principal stresses and principal planes
3 To study the stresses and deformations induced in thin and thick shells
4 To compute slopes and deflections in determinate beams by various methods.
5 To determine stresses and deformation in circular shafts and helical spring due to torsion

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify the rigid and deformable bodies and types of trusses
CO2: Classify the various stresses developed in beams and spherical shells
CO3: Determine the deflection in shafts and deformation in spherical shells
CO4: Draw the shear force and bending moment diagrams of beams
CO5: Analyze the stresses and deformation in shafts, springs and spherical shells

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	-	-	-	-	-	-	1	-	-	1	2	1	-
2	3	2	1	-	-	1	-	-	1	-	-	1	2	2	1
3	2	3	2	1	-	1	-	-	2	-	-	2	3	2	1
4	3	3	2	2	1	1	-	-	2	2	1	2	3	3	2
5	3	3	3	2	1	2	1	1	2	2	2	3	3	3	2
Avg.	2.8	2.4	2	1.7	1	1.3	1	1	1.6	2	1.5	1.8	2.6	2.2	1.5

UNIT 1 STRESS, STRAIN AND DEFORMATION OF SOLIDS 09

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains

UNIT 2 ANALYSIS OF PLANE TRUSSES AND TRANSVERSE LOADING AND STRESSES IN BEAM 09

Determinate and indeterminate plane trusses – determination of member forces by method of joints, method of sections and method of tension coefficient. Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams-Theory of simple bending

UNIT 3 TORSION 09

Torsion formula - stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs - carriage springs

UNIT 4 DEFLECTION OF BEAMS 09

Computation of slopes and deflections in determinate beams - Double Integration method – Macaulay's method – Area moment method – Conjugate beam method.

UNIT 5 THIN CYLINDERS, SPHERES AND THICK CYLINDERS 09

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem

TEXT BOOKS:

1 Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2 Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007
3 Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
4 IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.

REFERENCE BOOKS:

1 Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2 Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2007
3 Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4 Ferdinand P. Been, Russell Johnson, Jr. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing co. Ltd., New Delhi, 2005.

U23AG404	**FARM TRACTORS AND ENGINE SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To introduce the students to the different systems and working principles of tractor.
2 To Demonstrate tractor engine and equipment maintenance
3 To understand the basic Transmission system.
4 To analyse the Hydraulic system.
5 To get acquainted with power tiller, bulldozer and tractor testing.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Describe and explain the fundamental components and operating principles of tractor engines and their associated systems.
CO2: Apply the knowledge of engine systems to analyze the operational functionality of a tractor's mechanical systems.
CO3: Apply the knowledge of transmission systems and steering geometry to analyze the operational functionality of a tractor's mechanical systems.
CO4: Analyze the performance of hydraulic systems in tractors and apply these principles to understand the theory of traction and tractive efficiency.
CO5: Analyze the salient features and turning mechanisms of specialized farm equipment and analyze the procedures and test codes involved in performance testing of tractors and power tillers.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	-	-	-	1	-	1	-	-	1	2	2	1
2	2	3	1	2	-	1	-	-	2	-	1	2	2	3	2
3	2	3	2	2	1	1	-	-	2	1	1	2	3	3	2
4	3	3	3	3	1	2	1	1	2	2	2	3	2	3	3
5	2	2	2	3	2	2	1	2	3	3	2	3	3	2	3
Avg.	2.4	2.4	2	2.5	1.3	1.5	1	1.5	2	2	1.3	2.2	2.4	2.6	2.2

UNIT 1 **TRACTORS ENGINE** **09**

Classification of tractors - Tractor engines - Construction of engine blocks - Cylinder head and crankcase - Features of a cylinder, Piston. Connecting rod and crankshaft - Firing order combustion chambers

UNIT 2 **ENGINE SYSTEMS** **09**

Valves - Inlet and outlet valves - Valve timing diagram - Air cleaner- exhaust – silencer - Cooling systems - Lubricating systems - Fuel system - Governor

UNIT 3 **TRANSMISSION SYSTEMS** **09**

Transmission - clutch and gearbox - Sliding mesh - constant mesh - Synchro mesh - Differential, Final drive - Final drive and wheels - Steering geometry - Steering systems

UNIT 4 **HYDRAULIC SYSTEMS** **09**

Hydraulic system - Hydraulic system and its working principles - Three-point linkage - Draft control - Weight transfer - Theory of traction – Tractive efficiency and tractor chassis mechanics – Tractive efficiency**.**

UNIT 5 **POWERTILLER, BULLDOZER AND TRACTOR TESTING** **09**

Power tiller-special features - Bulldozer- salient features and turning mechanism- Types of tests and test procedure of tractor – Test code for performance testing of tractors and power tillers

TEXT BOOKS:

1 Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999.

2 Ojha, T. P., & Srivastava, A. C. (2006). Farm Machinery and Power. Oxford & IBH Publishing Co. Pvt. Ltd.

REFERENCE BOOKS:

1 Jagdishwar Sahay. 2019. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi.

2 Michael, A.M. and Ohja, T.P. 2018. Principles of Agricultural Engineering Volume I. Jain Brothers, Jodhpur.

3 Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.

U23AG405 UNIT OPERATIONS IN AGRICULTURAL PROCESSING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

1 The students would be exposed to the fundamental knowledge in Evaporation.

2 To ensure that students begin to understand Filtration, Sedimentation process in processing industries.

3 To gain a preliminary understanding of Processing steps and sieve analysis methods.

4 To enhance knowledge in crystallization process.

5 To learn basic distillation steps in processing of agriculture produce.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Outline fundamental principles of evaporation, mechanical separation, size reduction, equilibrium separation, crystallization and distillation.

CO2: Explain operating principles, equipment features and process conditions involved in major unit operations.

CO3: Compute process parameters related to evaporation, filtration, sedimentation, size reduction, extraction and distillation.

CO4: Analyse the performance, efficiency and limitations of unit operation equipment under different operating conditions.

CO5: Assess integrated unit operation systems for effective separation, concentration and purification in food processing industries.

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	1	-	-	1	2	1	-
2	2	2	-	-	-	1	-	-	1	-	-	1	2	2	1
3	2	3	1	2	-	1	-	-	2	-	-	2	3	2	1
4	3	3	2	3	1	2	1	1	2	2	2	2	2	3	2
5	2	2	3	3	2	2	2	2	3	3	3	3	3	2	3
Avg.	2.4	2.5	2	2.7	1.5	1.5	1.5	1.5	1.8	2.5	2.5	1.8	2.4	2	1.8

UNIT 1 EVAPORATION AND CONCENTRATION **09**

Unit operations in food processing – dimensions and units – dimensional and unit consistency – dimensionless ratios-evaporation – definition – liquid characteristics

– single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator

UNIT 2 MECHANICAL SEPERATION 09

Filtration – definition –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance-filtration equipment – rotary vacuum filter – filter press-sedimentation – gravitational sedimentation of particles in a fluid – Stoke's law, sedimentation of particles in gas-cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment.

UNIT 3 SIZE REDUCTION 09

Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products-energy and power requirements in comminuting – crushing efficiency – Rittinger's, Bond's and Kick's laws for crushing-size reduction equipment – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.

UNIT 4 CONTACT EQUILIBRIUM SEPARATION PROCESS 09

Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions - gas – absorption equipment-properties of tower packing – types – construction – flow through packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator – continuous leaching – decantation systems – extraction towers-washing – equipment

UNIT 5 CRYSTALLIZATION AND DISTILLATION 09

Crystallization-Equilibrium –Rate of crystal growth stage-Equilibrium crystallization-Crystallizers-Equipment-Classification- Construction and operation – Crystallizers-Tank-Agitated batch-Swenson-Walker and Vacuum crystallizers-Distillation-Binary mixtures-Flash and differential distillation-Steam distillation –Theory-Continuous distillation with rectification –Vacuum distillation - Batch distillation-Operation and process-Advantages and limitation-Distillation equipment-Construction and operation-Factors influencing the operation.

S.NO LIST OF EXPERIMENTS

1. Determination of economy and thermal efficiency of rotary flash evaporator
2. Studies on single and multiple effect evaporator
3. Determination of separation efficiency in centrifugal separation
4. Determination of collection efficiency in cyclone separator
5. Determination of efficiency of liquid-solid separation by filtration
6. Performance evaluation of pin mill

7 Performance evaluation of hammer mill

8 Performance evaluation of plate and frame filter press

TEXT BOOKS:

1 Earle, R.L., "Unit operations in Food Processing", Pergamon Press, Oxford, U.K, 1985.

2 McCabe, W.L., and Smith, J.C., "Unit Operations of Chemical Engineering", Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo, 1990.

3 Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003

REFERENCE BOOKS:

1 Coulson, J.M and J.F. Richardson. Chemical Engineering. Volume I to V. The Pergamon Press. New York, 1999.

2 Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press LLC, Florida, 2003.

3 Fellows, P (2009). Food processing Technology: Principles and Practice (3rd edition). Abington: Woodhead Publishing Ltd.

U23CY402	**ENVIRONMENTAL ECOSYSTEM AND SUSTAINABILITY**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

1 To study the interrelationship between living organism and environment

2 To assess the environmental pollution and its impact.

3 To understand the significance of natural resources and their conservation.

4 To identify and implement scientific, economic and political solutions to environmental problems.

5 Understand the influence of human population on environmental issues and role of information technology as a tool to minimize the environmental problems.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Understand the basis of ecological principles and environmental regulations which in turn helps in sustainable development and human population and environment. Use and over exploitation of forest and water and food resources.

CO2: Understand various schemes for the protection of species, role of an individual in prevention of pollution and conservation of natural resources.

CO3: Understand design of pollution control structures, resettlement and rehabilitation of people, welfare about the women and child.

CO4: Apply enough knowledge of implement various Environmental ethics, regulations and schemes, Pandemic issues and management, dams-benefits and problems, conservation of biodiversity.

CO5: Analyze the disaster management – floods, earthquake, cyclone and landslides. Water logging, salinity, climate change, global warming, acid rain and ozone layer depletion.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	-	-	-	-	2	3	1	-	-	-	2	2	1	1
2	1	1	-	-	-	2	3	2	2	-	-	2	1	2	2
3	1	-	3	-	1	3	2	2	-	1	1	1	1	2	1
4	2	2	2	-	-	2	3	3	1	2	1	2	2	2	2
5	2	3	2	2	2	3	3	2	2	2	2	3	2	2	3
Avg.	1.6	2	2.3	2	1.5	2.4	2.8	2	1.7	1.7	1.3	2	1.6	1.8	1.8

UNIT 1 **ECOSYSTEMS AND BIODIVERSITY** **06**

Definition, Scope and importance of environment - Concept of an ecosystem - Structure and function of an ecosystem (Grassland and River ecosystem only) - Food chains, Food webs and ecological pyramids - Introduction to biodiversity- Definition- Genetic, Species and ecosystem diversity - Value of biodiversity - Threats to biodiversity- Conservation of biodiversity. Case study of simple ecosystems -pond, river, hill slopes, etc.

UNIT 2 **ENVIRONMENTAL POLLUTION** **06**

Definition - Causes, Effects and control measures of (a) Air pollution (b) Water pollution (c) Thermal pollution - Solid waste management: Causes, Effects and control measures of municipal solid wastes - Role of an individual in prevention of pollution - Pollution case studies -Disaster management - Floods, Earthquake, Cyclone and landslides. Case study of local polluted site - Urban / Rural / Industrial / Agricultural.

UNIT 3 **NATURAL RESOURCES** **06**

Forest resources - Use and over-exploitation, Deforestation - Water resources - Use and over-utilization of surface and ground water, Drought, Conflicts over water, dams-Benefits and problems - Food resources- Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer-pesticide problems, water logging, Salinity-Role of an individual in conservation of natural resources (National and International level).

UNIT 4 **SOCIAL ISSUES AND SUSTAINABILITY MANAGEMENT** **06**

Unsustainable to sustainable development- millennium development goals, and protocols- Sustainable Development Goals-targets- Zero waste and R concept - ISO 14000 Series- Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials- Sustainable transports – Carbon credit, Carbon footprint, Climate change, Global warming, Acid rain, Ozone layer depletion.

UNIT 5	**HUMAN POPULATION AND THE ENVIRONMENT**	**06**

Population growth, Variation among nations -Population explosion - Family welfare programme - Environment and human health -Value education - Pandemic issues and management-Women and child welfare - Role of information technology in environment and human health - Case studies

TEXT BOOKS:

1 Benny Joseph, "Environmental Science and Engineering", Tata McGrawHill, New Delhi, 2017.
2 Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2016.
3 George Tchobanoglous, Frank Kreith, "Handbook of Solid Waste Management" (McGrawHill Handbooks), McGraw-Hill Education, 2ndEdition July 2017.

REFERENCE BOOKS:

1 R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media. 2015.
2 ErachBharucha, "Textbook of Environmental Studies", Universities Press (I) Private Limited, Hydrabad, 2015.
3 Rajagopalan R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

E- Resources:

1. https://archive.nptel.ac.in/courses/102/104/102104068/
2. https://archive.nptel.ac.in/courses/105/103/105103205/
3. https://nptel.ac.in/courses/105104103
4. https://nptel.ac.in/courses/105101010
5. https://archive.nptel.ac.in/courses/109/104/109104150/

U23AG411	**STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

1 To understand the fundamental concepts of strength, stiffness, and stability of materials used in agricultural engineering applications.
2 To familiarize students with experimental techniques for testing the mechanical properties of materials like metals, wood, and composites.
3 To develop hands-on skills in conducting tensile, compression, impact, torsion, and hardness tests on different materials.
4 To interpret and analyze material behavior under different loading conditions, essential for agricultural machinery and structural applications
5 To relate theoretical concepts of material strength to practical applications in farm machinery, soil and water conservation structures, and post-harvest systems.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Demonstrate the ability to conduct mechanical property tests (tension, compression, shear, torsion, impact, and hardness) on different materials.

CO2: Analyze and interpret the experimental results of mechanical testing for understanding material behavior under different loading conditions

CO3: Evaluate the suitability of materials for specific agricultural applications based on strength and deformation characteristics

CO4: Apply knowledge of strength of materials to assess and improve the performance of agricultural machinery and structural components.

CO5: Develop problem-solving and technical skills in material testing, ensuring safety, accuracy, and ethical engineering practices.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	3	2	-	-	-	3	1	-	1	2	1	-
2	2	3	-	3	2	1	-	-	2	2	-	2	2	2	1
3	2	2	3	2	1	2	1	-	2	2	1	2	3	3	2
4	3	3	2	2	1	1	-	-	2	2	2	2	3	3	2
5	2	2	2	2	1	2	1	3	3	3	2	3	2	2	2
Avg.	2.4	2.2	2.3	2.4	1.4	1.5	1	3	2.4	2	1.7	2	2.4	2.2	1.8

S.NO	LIST OF EXPERIMENTS
1	Tension test on steel rod
2	Compression test on wood
3	Double shear test on metal
4	Torsion test on mild steel rod
5	Izod Impact test on metal specimen
6	Charpy Impact test on metal specimen
7	Rockwell Hardness test on metals
8	Brinell Hardness Tests on metals
9	Deflection test on metal beam
10	Compression test on helical spring

TEXT BOOKS:

1 Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2 Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007
3 Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.

4 IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.

REFERENCE BOOKS:

1 Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2 Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2007
3 Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4 Ferdinand P. Been, Russell Johnson, Jr. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 2005.

U23AG412 FARM TRACTORS AND ENGINE SYSTEM LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1 Make the students conversant with the anatomy of farm tractor and farm engines.
2 Make them understand the working principle of IC engines, clutch, gear box, differential and final drive.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify tractors, power tillers, engines and major farm machinery systems and components.
CO2: Explain the construction and working principles of petrol engines, diesel engines and tractor subsystems.
CO3: Operate engine working models and tractor systems to demonstrate power transmission, braking, steering and hydraulics.
CO4: Perform dismantling, assembly and inspection of engine and transmission components following standard procedures
CO5: Evaluate the functioning of mechanical, hydraulic and electrical systems in tractors for effective field operation.

CO-PO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	2	-	-	-	-	1	-	-	1	2	2	1
2	3	2	-	2	-	1	-	-	2	-	-	2	2	3	2
3	2	3	2	3	1	1	-	-	3	2	1	2	3	3	2
4	2	2	2	3	1	1	1	2	3	2	2	3	2	2	3
5	1	3	3	3	2	2	2	2	3	3	3	3	3	3	3
Avg.	2.2	2.5	2.3	2.6	1.3	1.3	1.3	2	2.6	2.3	2	2.2	2.4	2.6	2.2

S.NO	LIST OF EXPERIMENTS
1	Identification and study of tractors, power tillers and bulldozers.
2	Identification and study of different components of petrol and diesel engine.
3	Method of working of diesel and petrol engine with the help of working models
4	Study of clutch – components and method of working
5	Study of gear box – components and method of working 8
6	Dismantling and assembly of diesel engine
7	Study of differential and final drive– components and method of working
8	Study of braking system and steering system – components and method of working
9	Study of hydraulic system and PTO system in a tractor
10	Study of electrical system, instruments in the dash board and controls – components: dynamo, starting motor, battery, lights, horn, odometer, amperemeter, accelerator, brake, differential lock, PTO lever, hydraulic lever, draft and position control lever.

TEXT BOOKS:

1 Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999.
2 Ojha, T. P., & Srivastava, A. C. (2006). Farm Machinery and Power. Oxford & IBH Publishing Co. Pvt. Ltd.

REFERENCE BOOKS:

1 Jagdishwar Sahay. 2019. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi.
2 Michael, A.M. and Ohja, T.P. 2018. Principles of Agricultural Engineering Volume I. Jain Brothers, Jodhpur.
3 Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.

SEMESTER V

U23AG501 AGRICULTURAL EXTENSION

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

1 To familiarize with proper communication techniques
2 To expose the students to different extension teaching methods
3 Utilizing all the electronic media for transfer of technology

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Describe communication concepts, models, diffusion processes and capacity-building approaches in extension systems.

CO2: Demonstrate extension teaching methods, programme planning steps and adoption behaviour of farmers.

CO3: Explain appropriate communication methods, audio-visual aids and modern ICT tools for extension delivery.

CO4: Apply adoption patterns, innovation attributes and effectiveness of extension programmes.

CO5: Apply extension strategies and capacity-building initiatives for sustainable agricultural development.

CO-PO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	0	0	0	1	0	2	2	0	2	2	1	1	2
2	2	2	0	0	0	1	0	1	2	0	2	2	2	1	2
3	2	2	1	0	0	1	0	2	2	0	2	2	2	1	2
4	1	1	2	0	1	2	0	2	3	2	2	3	2	2	1
5	3	2	3	2	0	3	2	2	2	2	3	2	3	2	3
Avg.	2	1.6	2	2	1	1.6	0	1.8	2.2	2	2.2	2.2	1.8	1.4	2

UNIT 1 COMMUNICATION AND PROGRAMME PLANNING 06

Communication – meaning – definition – models – Aristotle, Shanon-Weaver, Berlo,
Schramm, Leagans, Rogers & Shoemaker elements and their characteristics – types and barriers in communication. Programme planning – meaning, definition, principles, steps in programme development process, monitoring and evaluation of extension programmes.

UNIT 2 **EXTENSION TEACHING METHODS** **06**

Extension teaching methods - Audio-Visual aids – definition – classification – purpose, planning and selection, combination and use – individual, group and mass contact methods – merits and demerits.

UNIT 3 **MODERN COMMUNICATION GADGETS** **06**

Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone

UNIT 4 **DIFFUSION AND ADOPTION** **06**

Diffusion – meaning and elements. Adoption – meaning – adopter categories and factors influencing adoption, stages of adoption, Innovation decision process and attributes of innovation consequences of adoption.

UNIT 5 **CAPACITY BUILDING** **06**

Capacity building of extension personnel and farmers – meaning – definition, types of training, training to farmers, farm women and rural youth, FTC & KVK.

FOR FURTHER READING

The Challenger case study: Bhopal Gas Tragedy: The Three Mile Island and Chernobyl case studies: Fundamental Rights, Responsibilities and Duties of Indian Citizens: Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers India, Indian Institute of Materials Management

TEXT BOOKS:

1 Berlo, D.K. 1960. The Process of Communication. Holt, Rinehart and Winston, New York
2 Dass, R. 1981. Appropriate Technology - Percepts and Practices Vintage Press Inc., New York

REFERENCE BOOKS:

1 Ray, G.L. 1991. Extension Communication and Management. Kalyani Publishers, Kolkata
2 Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014
3 M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012
4 R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006

U23AG502 FARM MACHINERY AND EQUIPMENT

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

1 Introduce students to the fundamentals of farm mechanization and the working principles of various tillage, sowing, weeding, and harvesting equipment.
2 Provide hands-on exposure to adjustments, operations, and calibration of farm implements and machinery
3 Enable understanding of crop-specific machinery and equipment selection
4 Build practical skills in tractor, power tiller, and implement operation for effective field performance.
5 Develop safety awareness and promote maintenance practices for farm equipment.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and explain the principles, components, and classification of tillage, sowing, and harvesting implements.
CO2: Understand and apply appropriate adjustments and calibration procedures for ploughs, seed drills, planters, and sprayers.
CO3: Operate and evaluate the performance of farm machinery like tractors, power tillers, and harvesting equipment under field conditions.
CO4: Analyze and compare different farm implements and machinery based on crop, soil, and climatic requirements for field applications.
CO5: Demonstrate safe operational practices and routine maintenance of farm machinery and perform field-based assessment of machinery efficiency.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	-	-	-	2	2	1	3	1	1
2	2	3	-	2	2	-	-	-	2	1	2	2	3	1
3	1	2	-	3	1	3	-	2	3	2	2	2	3	2
4	2	3	2	3	-	-	2	-	2	2	1	3	2	2
5	1	-	-	2	-	3	2	3	3	2	2	2	2	3
Avg.	1.8	2.6	2	2.5	1.5	3	2	2.5	2.4	1.8	1.6	2.4	2.2	1.8

UNIT 1 FARM MECHANIZATION **09**

Farm mechanisation – objectives. Tillage - objectives - methods – primary tillage implements - secondary tillage implements - animal drawn ploughs - construction. Types of farm implements – trailed, mounted . Field capacity - forces acting on tillage tool.

UNIT 2 PRIMARY AND SECONDARY TILLAGE IMPLEMENTS **09**

Mould board plough- attachments – mould board shapes and types. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough - Rotary plough. Cultivators - types - construction. Disc harrows - Bund former - ridger – leveller. Basin lister-Wetland preparation implements.

UNIT 3 SOWING AND FERTILIZING EQUIPMENT **09**

Crop planting - methods - row crop planting systems - Devices for metering seeds – furrow openers – furrow closers- types – Types of seed drills and planters – calibration-fertilizer metering devices - seed cum fertilizer drills – paddy transplanters – nursery tray machines.

UNIT 4 WEEDING AND PLANT PROTECTION EQUIPMENT **09**

Weeding equipment – hand hoe – long handled weeding tools – dryland star weeder – wetland conoweeder and rotary weeder – Engine operated and tractor weeders. Sprayers –types classification – methods of atomization, spray application rate, droplet size determination.

UNIT 5 HARVESTING MACHINERY **09**

Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder combine harvesters, balers, threshers, tractor on top combine harvester, combine losses

S.NO	**LIST OF EXPERIMENTS**
1	Identification of major systems of a tractor and general guidelines on preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.
2.	Identification of components of power tiller, their maintenance and study on preliminary check measures and safety aspects before starting a power tiller - procedure for starting, running and stopping the power tiller.
3.	Field operation and adjustments of ploughs
4.	Field operation and adjustments of harrows
5.	Field operation and adjustments of cultivators
6.	Field operation of sowing and planting equipment and their adjustments
7.	Field operation of plant protection equipment
8.	Field operation on mowers
9.	Hitching of agricultural implements and trailers
10.	Visit to agro implement units.

TEXT BOOKS:

1 Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.,2010

2 Michael and Ohja. Principles of Agricultural Engineering. Jain brothers, New Delhi., 2005

3 Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributers, Delhi. 99, 1997.

4 Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990.

REFERENCE BOOKS:

1 Harris Pearson Smith et al. Farm machinery and equipment. Tata McGraw-Hill pub., New Delhi.,1996.

U23AG511	DESIGN AND DRAFTING OF AGRICULTURAL MACHINERY ELEMENTS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1 Provide practical skills in using CAD software for modeling farm machinery components.
2 Enable students to visualize and draft 2D and 3D models of individual parts and assemblies
3 Impart knowledge on the fit, tolerance, and motion aspects in agricultural machinery.
4 Encourage students to simulate working mechanisms of commonly used tools and equipment.
5 Develop creativity and critical thinking in the digital design of custom farm machinery elements.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify the types and functions of standard farm machinery components used in digital drafting.
CO2: Demonstrate the construction and layout of typical machine elements such as blades, gears, and joints through CAD-based drawing.
CO3: Apply and analyze CAD tools to model and assemble farm equipment parts with appropriate constraints and material properties.
CO4: Analyze the mechanical compatibility of parts in an assembly using section views, exploded views, and motion analysis.
CO5: Evaluate and improve an existing farm machinery element by redesigning it using CAD tools to meet performance or ergonomic requirements.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	1	0	0	2	0	0	2	2	0	1	3	2	1
2	2	3	1	2	3	1	0	2	1	1	2	2	3	1
3	1	2	3	3	2	2	2	3	2	2	2	2	3	2
4	2	3	2	3	2	2	0	2	2	1	1	3	2	2
5	1	2	3	2	2	3	3	3	2	2	3	2	2	3
Avg.	1.8	2.2	2.3	2.5	2.2	2	2.5	2.4	1.8	1.5	1.8	2.4	2.4	1.8

S.NO	**LIST OF EXPERIMENTS**
1	Introduction to CAD software – Interface and basic tools
2	2D drawing and dimensioning of a mould board plough share
3	2D modeling of knuckle joint and gear box
4	2D modeling of the parts of engine connecting rod.
5	Modeling of planter furrow opener and closer system
6	2D sectional view of a seed metering mechanism
7	Modeling of a plunger pump assembly
8	Design and drafting of Weeder
9	Design of flywheel or clutch plate of a thresher
10	Modeling of a straw baler plunger and piston assembly
11	2D modeling of **tractor**
12	Design mini-project: 3D modeling of a selected farm equipment

REFERENCE BOOKS:

1 Vijay Duggal. “A general guide to Computer Aided Design & Drafting, Mailmax Publications, 2000
2 Tadeusz Stolarski et al. “Engineering Analysis with ANSYS Software”, Butterworth Heinemann Publications, 2006
3 Louis Gary Lamit, “Introduction to Pro/ENGINEER” SDC Publications, 2004.

U23AG512 **INTERNSHIP**

L	T	P	C
0	0	0	1

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Get trained in the field work by attaching to any industry/organization

CO2: Have firsthand knowledge of practical problems in Agricultural Engineering

CO3: Gain working experience and skills in carrying out engineering tasks related to various fields of agriculture

CO4: Apply engineering principles to real-world agricultural problems

CO5: Write report on the work done

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	2	-	-	-	-	2	3	3	2	2	2	2	1	1
2	3	3	1	2	-	3	-	2	1	-	3	3	2	1
3	2	2	3	3	2	2	2	3	2	3	2	2	3	2
4	3	3	3	2	1	3	-	2	1	2	2	3	2	2
5	-	-	-	-	2	-	2	2	3	1	2	1	2	1
Avg.	1.8	2.2	2.3	2.5	2.2	2	2.5	2.4	1.8	1.5	1.8	2.4	2.4	1.8

SEMESTER VI

U23AG601 FOOD AND DAIRY ENGINEERING **L T P C**

COURSE OBJECTIVES:

1 The students would be exposed to the fundamental knowledge in Properties of milk
2 To ensure that students begin to understand drying process in processing industries.
3 To gain a preliminary understanding of Processing steps involved in milk processing.
4 To enhance knowledge in processing of dairy products.
5 To learn basic filtration steps in processing and dairy plant design layout.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Understand the different processing methods in dairy industry
CO2: Analyze the unit operations involved in processing steps
CO3: Recognize the working principles of various unit operations in dairy processing
CO4: Gain sufficient knowledge on processing of different dairy products
CO5: Have knowledge on dairy plant layout and filtration procedures in dairy industry

UNIT 1 PROPERTIES AND PROCESSING OF MILK **09**

Dairy Industry-importance and status; Milk Types – Composition and properties of milk, Production of high-quality milk, Method of raw milk procurement and preservation - Processing

UNIT 2 DRYING AND DEHYDRATION **09**

Moisture content - free moisture - bound and unbound moisture - equilibrium moisture content - Water activity - sorption behavior of foods - types of dryers - drum, spray, Freeze drying, dryers-advantages and disadvantages - dehydration

UNIT 3 MILK PROCESSING **09**

Physical, chemical, thermal and rheological properties of milk - storage tanks. Receiving handling and testing of milk - storage. Pasteurization - application-equipment - Low Temperature Long Time - High Temperature Short Time - Ultra High Temperature pasteurization, filling and packaging of milk and milk products

UNIT 4 PROCESSING OF DAIRY PRODUCTS **09**

Manufacture of Milk Powder, Processing of Milk Products - Condensed Milk - Skim milk - Butter milk - Flavored Milk, Whey, casein, yoghurt and paneer, Manufacture of Butter - Cheese, Ghee, ice creams and frozen desserts - Packaging of Milk and Milk Products

UNIT 5 FILTRATION EQUIPMENT AND DESIGN LAYOUT **09**

Filtration: principle, types of filters; Membrane separation, RO, Nano-filtration, Ultra filtration and Macro-filtration, equipment and applications- Dairy plant design and layout-CIP, Dairy effluent treatment plant

TEXT BOOKS:

1 H.G.Kessler, Food Engineering and Dairy Technology, Freising, Germany, Verlag A.Kessler, 1981
2 Sukumar De, Outlines of Dairy: Technology, Oxford University Press, 2001
3 Minj, Jagrani, Aparna Sudhakaran, and Anuradha Kumari, eds. Dairy Processing: Advanced Research to Applications. Singapore: Springer, 2020

REFERENCE BOOKS:

1 R. Paul Singh and Dennis R. Heldman. Introduction to Food Engineering. 5th edition Academic Press, USA. 2013.
2 Heldman, Dennis R., Daryl B. Lund, and Cristina Sabliov, eds. Handbook of food engineering. CRC press, 2018.

U23AG602	**IRRIGATION AND DRAINAGE ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

COURSE OBJECTIVES:

1 Provide fundamental knowledge of water resources and crop water requirements for efficient irrigation planning.
2 Introduce modern and traditional irrigation methods and their suitability based on field and crop conditions.
3 Equip students with understanding and design aspects of headworks, dams, canal structures, and water control systems.
4 Develop skills for analyzing command area development, water distribution, and irrigation system efficiency.
5 Apply drainage principles and design systems to manage waterlogging, drainage quality, and reuse.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and explain the concepts of water resources, irrigation planning, and crop water requirements.
CO2: Apply methods of irrigation and understand their suitability along with operation strategies in command area development.
CO3: Analyze diversion and impounding structures for irrigation storage and flow regulation based on technical design principles
CO4: Apply and analyze hydraulics, alignment, canal design theories, and regulatory structures in surface irrigation systems.
CO5: Apply drainage design principles to solve waterlogging problems and improve irrigation water quality through reuse strategies.

UNIT 1 **WATER RESOURCES AND IRRIGATION REQUIREMENT** **09**

Water Resources- River basins -Development and Utilization in India and Tamil Nadu-Irrigation – duty and delta - Rooting characteristics - Moisture use of crop,

Evapotranspiration - ET plot - Crop water requirement - Effective rainfall - Scheduling - Irrigation requirement - Irrigation frequency, Irrigation efficiencies.

UNIT 2 METHODS OF IRRIGATION AND COMMAND AREA DEVELOPMENT 09

Methods of Irrigation – Surface and Subsurface methods – Drip and Sprinkler - Underground pipeline irrigation system- Command area - Concept, Components of CADP - On Farm Development works, Farmer‟s committee - its role for water distribution and system operation - rotational irrigation system.

UNIT 3 DIVERSION AND IMPOUNDING STRUCTURES 09

Water control and diversion structure -Head works –Weirs and Barrage –Types of impounding structures - Factors affecting, location of dams -Forces on a dam - Design of Gravity dams- Earth dams, Arch dams – Spillways -Energy dissipaters.

UNIT 4 CANAL IRRIGATION 09

Hydraulics and design - Erodible and non-erodible, Materials for lining water courses and field channel, Classification of canals- Alignment of canals – Design of irrigation canals– Regime theories- Kennedy‟s and Lacey‟s theories - Canal Head works – Canal regulators - Canal drops – Cross drainage works – Canal Outlet, Escapes –Lining and maintenance of canals

UNIT 5 AGRICULTURAL DRAINAGE 09

Excess irrigation and waterlogging problem -Agricultural drainage - Drainage coefficient; principles of flow through soils, Darcy‟s law – infiltration theory, Surface drainage systems - Subsurface drainage - Design of subsurface drainage - Pipe materials - mole drains, drainage wells, Leaching requirements - irrigation and drainage water quality - recycling of drainage water for irrigation.

TEXT BOOKS:

1 Dilip Kumar Majumdar., “Irrigation Water Management”, Prentice-Hall of India, New Delhi, 2008.
2 Michael, A.M., “Irrigation Engineering”, Vikas Publishers, New Delhi, 2008..
3 Garg, S.K., “Irrigation Engineering,” Laxmi Publications, New Delhi, 2008.
4 Ritzema, H.P., “Drainage Principles and Applications”, Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands, 1994.

REFERENCE BOOKS:

1 Basak, N.N., “Irrigation Engineering”, Tata McGraw-Hill Publishing Co, New Delhi, 2008.
2 Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 1998.
3 Bhattacharya, A.K., and Michael, A.M., “Land Drainage – Principles, Methods and Applications”, Konark Publishers Pvt. Ltd., New Delhi, 2003.

U23AG603	RENEWABLE ENERGY IN AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

1 To provide fundamental knowledge on various renewable energy sources
2 To impart technical skills in biochemical conversion processes
3 To familiarize students with solar energy conversion systems
4 To enable students to understand wind energy principles
5 To introduce hydro and ocean energy technologies

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Predict the energy scenario and status of renewable energy sources and production in India
CO2: Apply the thermal conversion technologies for agro-products
CO3: Determine the potential of solar energy production
CO4: Use wind energy conversion system to meet the energy requirements of farms
CO5: Demonstrate energy conversion and energy auditing for agricultural farms

UNIT 1 **RENEWABLE ENERGY SOURCES** **09**

Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; types, construction, working principle, Biomass Combustion Technology, Gasifiers Technology, Biomass Gasification Methods, Removal of tar and impurities from gasification, Principles of pyrolysis and methods

UNIT 2 **BIOCHEMICAL CONVERSION TECHNOLOGY-BIOGAS AND BIO FUELS** **09**

Importance of biofuels, Biogas technology, Biogas plants types, Microbiology of biogas production, Size and selection for Biogas plant, Biogas plant- materials and methods for Construction. Bio-Fuels and characteristics, Bio-Diesel, Bio-Diesel production processes, Bio-Ethanol Production, BEA, running of biofuel engines

UNIT 3 **SOLAR ENERGY CONVERSION SYSTEM** **09**

Solar radiation, insolation, Solar thermal - concentrating & non- concentrating collectors- types reflectors – solar thermal power stations principle and applications - solar stills- types- solar pond performance- characteristics applications. Basics of Solar Photovoltaics, Recent trends in solar drying-solar tunnel drier, Solar Driers, Solar PV and water pumping, Solar Water Heater

UNIT 4 **WIND ENERGY CONVERSION SYSTEM** **09**

Nature of wind - wind structure and measurement - wind power laws, Wind mill - classification - power curve. Upwind and downwind systems, Wind energy conversion principles, Wind mill- aero generator, Wind mill- water pumping

UNIT 5 **HYDRO AND OCEAN ENERGY CONVERSION SYSTEM AND ENERGY AUDITING** **09**

Hydropower energy sources; hydropower types, sustainability; ocean energy

conversion system, ocean thermal energy conversion system – thermodynamic efficiency - cycle type environment effect - technical difficulties; energy auditing - carbon foot print

S.NO	LIST OF EXPERIMENTS
1	Problems on solar time, basic earth sun angles
2	Study of radiation measuring instruments - Visit to meteorology station
3	Characterization of biomass – proximate analysis
4	Design of KVIC / Deenbandhu model biogas plant
5	Testing of solar water heater
6	Study on Solar power and I-V Characteristics
7	Performance evaluation of a SPV water pumping system
8	Study on pyrolysis unit – Biochar, Charcoal and Tar making process
9	Study on the performance of wind energy conversion system
10	Study of wind measuring instruments

TEXT BOOKS:

1 Rai G.D, Non-conventional sources of Energy, Khanna publishers, New Delhi, 1995

REFERENCE BOOKS:

1 H. P. Garg, Treatise on Solar Energy, Vol.1 : Fundamentals of solar energy, John Wiley & sons Ltd, 1982

2 A.John. Duffie and William A. Beckman, Solar Engineering of Thermal Processes, 4th Edition ISBN: 978-0-470-87366-3, John Wiley and Sons Ltd, 2013

3 Jui Sheng Hsieh, Solar Energy Engineering, Prentice Hall, London

4 Solanki Chetan Singh, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice- Hall of India Pvt. Limited, 2009

5 J.F.Manwell, J.G. McGswan and A.L.Rogers, Wind Energy Explained. Theory, Design and Application, John Wiley and Sons Ltd, 2004

SEMESTER VII

U23AG701 SOIL AND WATER CONSERVATION ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Get a sound knowledge in the problems associated with soil erosion.
2 Introduce the estimation of soil erosion.
3 Impart knowledge in various practices to control erosion.
4 Study about the water conservation principles and techniques.
5 Get an idea about sedimentation and its control measures.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Gain fundamental knowledge on the concepts of erosion and sedimentation.
CO2: Gain knowledge about evolution of Universal Soil Loss Equation: and its applications.
CO3: Explain and design erosion control measures types and design specifications
CO4: Have sufficient knowledge on soil and water conservation measures.
CO5: Have sufficient knowledge on reservoir sedimentation and sediment control methods.

UNIT 1 SOIL EROSION PRINCIPLES **09**

Approaches to soil conservation – Soil conservation in India - Erosion – Agents - Causes - Mechanics of water erosion – Soil erosion problems - Types of water erosion: Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion, Stream bank erosion – Classification of Gully – Gully Control Structures: Drop Spillway, Drop Inlet, Chute Spillways - Prerequisites for soil and water conservation measures.

UNIT 2 ESTIMATION OF SOIL EROSION **09**

Runoff computation for soil conservation: SCS-CN method – Evolution of Universal Soil Loss Equation: Applications and Limitations – Modified Universal Soil Loss Equation – Revised Universal Soil Loss Equation- Permissible erosion – Land use capability classification - Classification of eroded soils

UNIT 3 EROSION CONTROL MEASURES **09**

Agronomic practices: contour cultivation - strip cropping – tillage practices – Soil management practices – Bunding: Types and design specifications - Mechanical measures for hill slopes – Terracing: Classification and design specification of bench terrace – Grassed waterways: Location, construction and maintenance – Types of temporary and permanent gully control structures

UNIT 4 WATER CONSERVATION MEASURES **09**

In-situ soil moisture conservation – Water harvesting principles and techniques: Micro catchments, catchment yield using morphometric analysis - Farm ponds: Components, Design, Construction and Protection – Check dams - Earthen dam – Retaining wall.

UNIT 5	**SEDIMENTATION**	**09**

Sediment: Sources – Types of sediment load – Mechanics of sediment transport – Estimation of bed load – Sediment Graph - Reservoir sedimentation: Basics - Factors affecting sediment distribution pattern, Rates of reservoir sedimentation - Silt Detention Tanks – sediment control methods

TEXT BOOKS:

1. Suresh, R., "Soil and Water Conservation Engineering", Standard Publication, New Delhi, 2007.
2. Ghanshyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, 2000.
3. "Sedimentation Engineering", 2006, ASCE manual and Report on Engineering Practice No. 54, Edited by Vito A. Vanoni. ASCE publishing.

REFERENCE BOOKS:

1. Murthy, V.V.N., "Land and Water Management Engineering", Kalyani Publishers, Ludhiana, 1998.
2. Gurmail Singh, "A Manual on Soil and Water Conservation", ICAR Publication, New Delhi, 1982.
3. Mal, B.C., "Introduction to Soil and Water Conservation Engineering", Kalyani Publishers, New Delhi, 2002

U23AG702	**REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To introduce the principles and basic concepts of Remote Sensing and GIS
2. To introduce the remote sensing systems, data products and analysis
3. To introduce concepts of GIS, Map and their influences
4. To introduce the spatial data models, analysis and presentation techniques
5. To study the applications of Remote Sensing and GIS in agriculture, soil and water resources

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and explain the fundamental principles, components, and types of remote sensing and GIS, including electromagnetic spectrum and map elements.

CO2: Interpret satellite data, resolutions, and spectral signatures; differentiate between image data products and elements of visual interpretation.

CO3: Apply image enhancement, classification, and processing techniques for extracting meaningful information from multispectral satellite imagery.

CO4: Analyze geospatial data models, spatial queries, buffering, overlays, and perform basic spatial analysis using GIS tools.

CO5: Apply and analyze the use of RS and GIS tools in agricultural and environmental applications including crop assessment, soil classification, and water modeling.

UNIT 1 **CONCEPTS OF REMOTE SENSING AND SATELLITES** **09**

Definition- Historical background - Components of remote sensing – Energy source, electromagnetic spectrum, radiation principle, platforms and sensors - Active and passive remote sensing interference - Atmospheric effects on remote sensing – Energy interaction with earth surface feature - Data acquisition - Reflectance, spectral signatures for water, soil and vegetation. Satellites - Types - Sun synchronous - Geo synchronous remote sensing satellites - LANDSAT, SPOT & IRS - Resolution - Spectral, spatial, radiometric and Temporal resolution - Recent satellites with its applications

UNIT 2 **DATA PRODUCTS AND IMAGE ANALYSIS** **09**

Types of Data Products - types of image interpretation - basic elements of image interpretation -visual interpretation keys - Digital Image Processing - Preprocessing - image enhancement techniques - multispectral image classification - Supervised and unsupervised – Vegetation Indices.

UNIT 3 **CONCEPTS OF GIS** **09**

Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems – Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software.

UNIT 4 **DATA INPUT AND ANALYSIS** **09**

Data – Spatial, Non-Spatial – Database models – Hierarchical network, Relational and Object-Oriented Data Models – Raster and Vector – Methods of Data input – Data Editing – Files and formats – Data structure – Data compression. Introduction to analysis – Measurements – Queries – Reclassification – Simple spatial analysis – Buffering – Neighboring functions – Map overlay – Vector and raster – Spatial interpolation – Modelling in GIS – Digital Elevation Modelling – Expert systems

UNIT 5 **APPLICATION OF RS AND GIS** **09**

Crop Acreage estimation - Estimation of Crop Water Requirement – Crop condition - Soil mapping – classification of soil with digital numbers – soil erosion mapping-reservoir sedimentation using image processing– water quality modeling – Cropping pattern change analysis-Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health.

TEXT BOOKS:

1 Anji Reddy. M, Remote Sensing and Geographical Information Systems, BS Publications, Hyderbad, 2001
2 Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.

REFERENCE BOOKS:

1 Bettinger, P., and Michael, G.W., “Geographical Information System: Applications in Forestry and Natural Resources Management,” Tata McGraw–Hill Higher Education, New Delhi, 2003
2 Ian Heywood., “An Introduction to GIS”, Pearson Education, New Delhi, 2001.

3 Jeffery Star and John Estes, "Geographical Information System – An Introduction," Prentice Hall India Pvt. Ltd., New Delhi, 1998.
4 Patel A.N & Surendra Singh, "Remote sensing principles & applications", Scientific Publishers , Jodhpur 1992

U23AG703	AUTOMATION IN AGRICULTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1 To impart foundational knowledge of electronics and digital systems
2 To develop understanding and application skills in precision farming technologies
3 To introduce the fundamentals and applications of robotics in agriculture
4 To provide hands-on knowledge of IoT-based sensing and control systems
5 To equip students with the ability to design and integrate IoT- and automation-based solutions

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Exemplify the working operations of electronic devices and processors
CO2: Interpret the necessity of sensor requirements for precision farming practices
CO3: Understand the basics of robotics and their applications in agriculture
CO4: Apply the IOT concepts in cropping practices
CO5: Interpolate the concept of automation in governing the agricultural systems

UNIT 1 INTRODUCTION **09**

Fundamental of electronics Passive devices -semiconductor devices - transistors - diode circuits - amplifier circuits. Integrated circuits and operational amplifier - logic gates - flip flop - counters digital to analog - analog to digital converters- microprocessor.

UNIT 2 PRECISION FARMING **09**

Precision farming -Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modelling.

UNIT 3 ROBOTICS IN AGRICULTURE **09**

Fundamental of Robotics - types – application. Agricultural robots - types- function - application. Future trends in automation in agriculture

UNIT 4 AUTOMATION USING IoT **09**

Use of different sensors - Temperature and humidity sensor - Soil Moisture Sensor - Water Level Depth Detector, Raspberry Pi Arduino UNO

UNIT 5 AUTOMATION OF AGRICULTURE OPERATION **09**

Automation of agricultural operations using IoT based systems - Smart Irrigation System- Automation in Greenhouse – Drones. Case Study- Automation of greenhouse/farm operations.

TEXT BOOKS:

1 Zhang, Q. and Pierce, F.J. eds., 2013. Agricultural automation: fundamentals and practices. CRC Press.
2 Choudhury, A., Biswas, A., Singh, T.P. and Ghosh, S.K. eds., 2022. Smart Agriculture Automation Using Advanced Technologies: Data Analytics and Machine Learning, Cloud Architecture, Automation and IoT.

REFERENCE BOOKS:

1 National Research Council, Precision Agriculture in the 21st Century, National Academies Press, Canada, 1997.
2 Young, S.L. and Pierce, F.J. eds., 2013. Automation: The future of weed control in cropping systems. Springer Science & Business Media.
3 Nof, S.Y. ed., 2009. Springer handbook of automation. Berlin, Heidelberg: Springer Berlin Heidelberg.
4 Billingsley, J., 2019. Robotics and automation for improving agriculture. Burleigh Dodds Science Publishing Limited.
5 McNulty, P. and Grace, P.M. eds., 2009. Agricultural Mechanization and Automation-Volume II (Vol. 2). EOLSS Publications.

U23AG711	**REMOTE SENSING AND GIS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

1 To introduce the principles and basic concepts of Remote Sensing and GIS through hands on training

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Gain sufficient knowledge on satellite data processing and available data products.
CO2: Know the concept of GIS and its tools.
CO3: Have knowledge on data input and analysis techniques
CO4: Utilize these advanced techniques in addressing problems in various fields of agricultural engineering.

S.NO	**LIST OF EXPERIMENTS**
1	Measurement of relief displacement using parallax bar
2	Stereoscopic vision test
3	Aerial photo interpretation - visual
4	Satellite images interpretation – visual
5	Introduction to QGIS
6	Geo-referencing of images
7	Image enhancement practice
8	Supervised classification practice
9	Unsupervised classification practice

10 Database Management Systems
11 Spatial data input and editing - Digitising
12 Raster analysis problems – Database query
13 GIS applications in DEM and its analysis
14 GIS application in watershed analysis

TEXT BOOKS:

1 Lillesand, T.M. and Kiefer, R.W. 2005. "Remote Sensing and Image Interpretation ", II edition. John Wiley & sons.
2 Heywood, I., Cornelius. S., Carver. S 2002. An Introduction to Geographical Information Systems. Addison Wesley Longman, New York.

REFERENCE BOOKS:

1 Floyd F.Sabins. 2005. "Remote Sensing: Principles and Interpretation", III edition. Freeman and Company New York.
2 Jensen, J.R., 2004. "Introductory Digital Image Processing: A Remote Sensing Perspective". Prentice – Hall. New Jerse

PROFESSIONAL ELECTIVES

VERTICAL I - FOOD AND AGRICULTURAL PROCESSING

U23AGP11 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Interpret principles of operation of different Refrigeration & Air conditioning systems
2 Understand the types of compressors and expansion devices and their applications
3 Combine the parameters involved in design of the various air conditioning and cold storage systems

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Summarize refrigeration principles, components, refrigerants and environmental considerations.
CO2: Explain vapour compression, vapour absorption systems and psychrometric concepts used in air conditioning
CO3: Calculate refrigeration capacity, COP, cooling and heating loads using standard charts and methods.
CO4: Analyse air conditioning systems, psychrometric processes and system performance under varying conditions.
CO5: Assess refrigeration and cold-chain applications for food processing, preservation and distribution

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	1	1
2	3	2	-	-	-	2	-	-	-	-	1	2	2	1
3	2	3	2	2	1	1	-	1	1	-	2	2	3	2
4	2	3	3	3	2	2	-	1	1	-	2	3	3	2
5	2	2	3	2	-	3	2	2	2	2	3	3	2	3
Avg.	2.4	2.5	2.7	2.3	1.5	2.2	2	1.3	1.3	2	1.8	2.6	2.2	1.8

UNIT 1 REFRIGERATION PRINCIPLES AND COMPONENTS 09

Refrigeration principles - refrigeration effect coefficient of performance -units of refrigeration - Refrigeration components -compressor-classification-principle and working- condensers-types construction, principle and working. Evaporators - types-principle and working. Expansion device types construction, principle and working. Refrigerants properties classification comparison and advantages chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants

UNIT 2 VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE 09

Simple vapour compression cycle - T-S diagram - p-h chart- vapour compression system-different types-vapour absorption cycle simple and practical vapour

absorption system- advantages- ideal vapour absorption system- Electrolux refrigerator Lithium bromide refrigeration-construction and principles.

UNIT 3 **APPLIED PSYCHROMETRY** **09**

Principle and properties of psychrometry, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor, apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load calculations

UNIT 4 **AIR CONDITIONING SYSTEM** **09**

Air conditioning systems-equipment used-classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system-unitary and central air conditioning system- application of refrigeration and air conditioning-domestic refrigerator and freezer- ice manufacture.

UNIT 5 **APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION** **09**

Cooling and heating load estimation, cold storage design, types of cooling plants for cold storage. Insulation properties and types of insulation material. Cold storage for milk, meat, fruits, vegetables, poultry and marine products. Refrigerated Transport, Handling and Distribution, Cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display. Sensors for cold storage management.

TEXT BOOKS:

1 Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010
2 Textbook of Refrigeration and Air-Conditioning (M.E.) by R.S. Khurmi, 2019

REFERENCE BOOKS:

1 ASHRAE Hand book, Fundamentals, 2010
2 JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3 Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4 Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.
5 A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput

U23AGP12 **POST HARVEST TECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1 Analyze post-harvest losses, harvesting stages, threshing systems, and moisture characteristics of cereals, pulses, and oilseeds.
2 Evaluate psychrometric processes and select appropriate drying methods and grain dryers for efficient moisture removal.
3 Assess cleaning and grading equipment performance based on separation efficiency and

quality improvement.

4 Analyze shelling and material-handling systems for effective post-harvest operations.

5 Evaluate crop processing techniques and optimize rice-mill layout for quality and value addition.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Understand post-harvest concepts, losses, harvesting stages and moisture characteristics of agricultural produce.

CO2: Explain psychrometric principles, drying mechanisms and separation processes used in grain handling.

CO3: Apply appropriate methods for drying, cleaning, grading, shelling and material handling of crops.

CO4: Analyse the performance of dryers, separators, shellers and conveying systems used in post-harvest operations

CO5: Analyse crop processing systems for cereals, pulses, oilseeds and millets to minimize losses and improve quality.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	-	-	-	-	1	3	1	1
2	3	2	-	-	-	1	-	-	-	-	1	2	2	1
3	2	2	3	2	2	3	-	1	1	1	2	3	3	2
4	2	3	2	3	2	2	-	1	1	-	2	2	3	2
5	1	3	3	2	-	3	2	2	2	2	3	3	2	3
Avg.	2.2	2.5	2.7	2.3	2	2.2	2	1.3	1.3	1.5	1.8	2.6	2.2	1.8

UNIT 1 FUNDAMENTALS OF POST HARVESTING 09

Post harvest technology – introduction –objectives –post harvest losses of cereals, pulses and oilseeds – importance - optimum stage of harvest. Threshing – traditional methods mechanical threshers – types-principles and operation-moisture content –measurement – direct and indirect methods – moisture meters – equilibrium moisture content.

UNIT 2 PSYCHROMETRY AND DRYING 09

Psychrometry – importance – Psychrometric charts and its uses – Drying – principles and theory of drying – thin layer and deep bed drying – Hot air drying – methods of producing hot air – Types of grain dryers – selection – construction, operation and maintenance of dryers – Design of dryers

UNIT 3 CLEANING AND GRADING 09

Principles - air screen cleaners – adjustments - cylinder separator - spiral separator – magnetic separator - colour sorter - inclined belt separator – length separators - effectiveness of separation and performance index.

UNIT 4 SHELLING AND HANDLING 09

Principles and operation – maize sheller, husker sheller for maize – groundnut decorticator – castor sheller – material handling – belt conveyor –screw conveyor – chain conveyor – bucket elevators – pneumatic conveying

UNIT 5	**CROP PROCESSING**	**09**

Paddy processing – parboiling of paddy – methods – merits and demerits – dehusking of paddy – methods – merits and demerits – rice polishers –types – constructional details – polishing –layout of modern rice mill - wheat milling – pulse milling methods – oil seed processing – millets processing.

TEXT BOOKS:

1 Chakraverty, A.Post harvest technology for Cereals, Pulses and oilseeds. Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition, 2000.
2 Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing. Vikas publishing house Pvt. Ltd., New Delhi, 1994

REFERENCE BOOKS:

1 Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.
2 Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955

U23AGP13	**PROCESSING OF FRUITS AND VEGETABLES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Implement specific post-harvest handling technique for storage and transport of fruits and vegetables
2 Apply preservation techniques to produce value added fruits and vegetable products
3 Learn the industrial scale processing and preservation methods to extend the shelf life of fruit and vegetable commodities

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify maturity indices, nutritional attributes and post-harvest characteristics of fruits and vegetables.
CO2: Interpret physiological changes, storage conditions and preservation mechanisms during handling and storage.
CO3: Demonstrate value-addition techniques such as drying, fermentation, minimal processing and product preparation
CO4: Differentiate quality deterioration, spoilage causes and storage challenges in processed fruit and vegetable products.
CO5: Appraise packaging systems, canning operations and commercial processing facilities for fruits and vegetables.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	-	-	-	-	1	3	1	1
2	3	2	-	-	-	3	-	-	-	-	1	2	2	1
3	2	2	3	2	2	3	1	2	2	1	2	3	3	3
4	2	3	2	3	-	3	-	1	1	-	2	2	2	2
5	1	2	3	2	2	3	2	2	2	2	3	3	3	3
Avg.	2.2	2.2	2.7	2.3	2	2.8	1.5	1.7	1.7	1.3	1.8	2.6	2.2	2

UNIT 1 **HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES** **09**

Fruits and vegetables: classification, nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - pre-cooling and storage - Storage under ambient condition, low temperature storage - chilling, frozen storage-chilling injury, freeze burn. Controlled atmosphere storage, Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

UNIT 2 **PRESERVATION OF FRUITS AND VEGETABLES BY VALUE ADDITION** **09**

Methods of fruit and vegetable preservation - Processing using sugar- Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated, fruit beverages. Processing using salt - Brining - Preparation of pickles, chutney and sauces, ketchup. Machinery involved in processing of fruits and vegetables products

UNIT 3 **PRESERVATION BY DRYING AND DEHYDRATION** **09**

Drying and dehydration - Types of driers - Solar, cabinet, fluidized bed drier, spouted bed drier, heat pump drier, vacuum drier and freeze drier - Applications. Preparation of product. Changes during drying and dehydration. Problems related to storage of dried and dehydrated products**.**

UNIT 4 **MINIMAL PROCESSING AND FERMENTATION** **09**

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal Processing of Fruits and Vegetables. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

UNIT 5 **CANNING AND BOTTLING** **09**

Formation of Films and pouches, Co-extruded films and Laminates Canning - principles, types of cans - preparation of canned products - packing of canned products - spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

TEXT BOOKS:

1 Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.

2 R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.

3 A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003

REFERENCE BOOKS:

1 Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
2 D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
3 K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.

U23AGP14 STORAGE AND PACKAGING TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To study about the different storage structures
2 To learn about the different packaging materials and various methods of packaging to improve the shelf life of the products
3 To understand the concepts of Controlled Atmosphere Storage and Modified Atmosphere Packaging

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recognize storage losses, grain properties, shelf-life factors and basic packaging requirements of food products
CO2: Discuss storage structures, fumigation methods, packaging materials and environmental effects on food quality.
CO3: Implement appropriate storage, controlled atmosphere and modified atmosphere packaging techniques for food commodities
CO4: Examine performance issues related to silos, packaging systems, gas permeability, spoilage and quality deterioration.
CO5: Justify the selection of advanced packaging systems, smart packaging technologies and storage solutions for food supply chains.

CO-POMAPPING

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	-	-	-	-	2	-	-	-	-	1	3	-	-
2	3	-	-	-	-	3	-	-	-	-	-	-	2	-
3	-	-	3	-	2	3	-	1	-	-	1	-	-	3
4	-	3	-	3	-	3	2	-	1	-	-	-	-	-
5	-	-	3	-	2	3	2	-	2	1	2	-	-	3
Avg.	3	3	3	3	2	2.8	2	1	1.5	1	1.3	3	2	3

UNIT 1 STORAGE ENVIRONMENT AND STORAGE STRUCTURES 09

Storage losses in agricultural commodities. Physical properties of grain affecting

storability- Treatments for enhancing shelf life- Fumigation Processes for bag storage piles. Rural storage structures- Bag Storage and its Design. Parameters and types of storage structure. Bulk Storage in silos and large Bins Construction of Silos, Problems of Silo storage, relative Costs of Silo and Bag Storage. Quality Changes and remedial measures of Grains during storages.

UNIT 2 INTRODUCTION TO PACKAGING 09

Introduction Protection of Food product's major role and functions of food packaging Effect of environmental factors, mechanical forces and biological factors on food quality and shelf life. Estimating the shelf-life requirement accelerated storage studies. Tests on packaging materials Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates

UNIT 3 CONTROLLED ATMOSPHERE STORAGE AND MODIFIED ATMOSPHERE PACKAGING 09

Introduction and concept of CA Storage Equipment for creating, maintaining and measuring controlled atmosphere - Biochemical aspects of CA storage - Static & Dynamic CA, Fruit Ripening, Hypobaric and Hyperbaric Storage. Effects of concentrations of compositional gases on Fruits and vegetables. MAP-Film & Coating types, Permeability, Gas Flushing, Perforation, Absorbents, Humidity, Temperature, Chilling Injury, Shrink wrapping, Vacuum Packing, Modified Interactive Packaging, Minimal Processing, Equilibrium Modified Atmosphere Packaging, Effect of scavengers

UNIT 4 CANNING 09

Metal Cans and Glass Bottles as Packaging. Types of Metallic cans. Basics of Canning operations, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles, advantages and problems, Bottle and jar closures, different types of caps and liners used. Plastics used and their Specific applications - Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Polyvinylidene Chloride (PVDC Diofan, Ixan andSaran), Polyvinyl chloride, Copolymers their applications. Closing and sealing of Rigid plastic containers Seal types.

UNIT 5 FLEXIBLE FILMS PACKAGING 09

Formation of Films and pouches, Co-extruded films and Laminates applications. Filling and sealing of pouches and flexible plastic containers, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging. Fabrication methods Thermo forming, Blow moulding, Injection moulding, Extrusion Blow moulding applications. Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging - applications. Nano packaging and smart packaging. Printing on packages, Bar codes, Nutrition labeling and legislative requirements. Sensors and IoT in Food packaging.

TEXT BOOKS:

1 Sahay, K.M. and K.K.Singh. 1996. Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd., New Delhi.
2 Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi.
3 Pandey, P.H.2002. Post harvest engineering of horticultural crops through objectives. Saroj Prakasam. Allahabad.

REFERENCE BOOKS:

1 Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
2 N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),

Oxford, UK,1994

3 Ruth H. Matthews: Pulses Ã¢?? Chemistry, Technology and Nutrition Mercel Dekker Inc., USA,1989

U23AGP15 FOOD PROCESS EQUIPMENT AND DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Impart knowledge on basic principles of designing equipment for food processing

2 To gain knowledge in the materials used and their properties for equipment design

3 To familiarize the working of different process equipment's

4 To understand the construction of material handling devices

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Familiarize with principles, materials, codes and selection criteria for food processing equipment.

CO2: Elucidate design considerations of storage structures, silos, pressure vessels and processing tanks

CO3: Solve design problems related to heat exchangers, evaporators and cooling systems using standard methods.

CO4: Critically analyze the design of extruders, freezers, cold storage facilities and thermal equipment.

CO5: Optimize material handling and separation equipment designs for efficient food processing operations.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	1	2	-	-	-	-	1	3	1	1
2	2	2	3	-	-	3	-	-	-	-	1	2	3	2
3	2	3	2	3	2	2	-	1	1	-	2	2	3	2
4	2	3	3	3	2	3	-	1	1	-	2	3	3	2
5	1	2	3	2	-	3	2	2	2	2	3	3	2	3
Avg.	2	2.5	2.7	2.7	1.7	2.6	2	1.3	1.3	2	1.8	2.6	2.4	2

UNIT 1 PROCESS EQUIPMENT DESIGN **09**

Introduction on process equipment design- principles and selection of food processing equipment - Design parameters and general design procedure- Material specification, Types of material for process equipment- Design codes Application of design engineering for processing equipment.

UNIT 2 DESIGN OF STORAGE STRUCTURES **09**

Design considerations for pressure vessels- design aspects of storage tanks- Horizontal and vertical silos- Silo design-Rankine Theory-Airy equation-Janssen equation- design of sterilizers and process vats

UNIT 3 **DESIGN OF HEAT EXCHANGERS** **09**

Design considerations of heat exchangers -LMTD- plate heat exchanger, shell and tube heat exchangers - design of finned type heat exchanger- design of single effect and multiple effect evaporators- Problems on tubular heat exchanger, shell and tube type heat exchanger and plate heat exchanger

UNIT 4 **DESIGN OF EXTRUDERS, FREEZERS AND COLD STORAGE** **09**

Design of food extruders – single and twin-screw extruders- Design of freezers – types of freezers –construction and operation- Design considerations for cold storage– factors to be considered - estimation of cooling load – construction and operation- maintenance of cold storage

UNIT 5 **DESIGN OF MATERIAL HANDLING AND SEPARATION DEVICES** **09**

Design -belt conveyor, bucket elevator, screw conveyor, chain conveyor, pneumatic conveyor- Disc separator -Spiral Separator-Specific gravity Separator- Pneumatic Separator-Inclined draper-Velvet roll Separator- Design of Cyclone separator -Magnetic Separator - Color Separator

TEXT BOOKS:

1 George D. Saravacos, Athanasios E. Kostaropoulos, Handbook of Food Processing Equipment, Springer, 2012, 1461352126, 9781461352129
2 Zacharias B. Maroulis, George D. Saravacos, Food Process Design, CRC Press, 2003, ISBN: 0203912012, 9780203912010
3 Amalendu Chakraverty, R. Paul Singh Postharvest Technology and Food Process Engineering, CRC Press, 2016, ISBN: 1466553219, 9781466553217

REFERENCE BOOKS:

1 Dennis Heldman, Food Preservation Process Design, Academic Press, 2011**ISBN:** 9780123724861
2 Sahay K.M. & Singh K.K, Unit Operations of Agricultural Processing, Vikas Publishing House Pvt Limited, 2nd Edition, 2004, ISBN: 8125911421, 9788125911425
3 Toledo R T, Fundamentals of Food Process Engineering, Springer, Fourth Edition (2018), ISBN: 9783319900971

U23AGP16	**FOOD QUALITY ANALYSIS AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Impart fundamental knowledge on food quality parameters and standards.
2 Understand methods of physical, chemical, and microbial analysis of food products.
3 Introduce quality assurance and quality control techniques in food industries.
4 Provide insights into food safety regulations and certifications.
5 Familiarize students with modern instrumentation used in food quality evaluation.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Define food quality attributes, hazards, compositional factors and regulatory standards governing food safety.

CO2: Illustrate physical, chemical and shelf-life evaluation methods used in food quality assessment.
CO3: Execute standard microbial, toxicological and residue analysis techniques for food safety evaluation.
CO4: Diagnose quality and safety issues in foods using quality control systems and certification frameworks.
CO5: Integrate instrumental techniques and quality management tools for comprehensive food quality assurance.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	2	-	-	-	1	3	1	1
2	3	2	-	-	2	2	-	-	-	-	1	2	2	1
3	2	2	-	3	2	3	1	2	2	-	2	2	3	2
4	2	3	2	3	-	3	2	1	1	-	2	3	3	2
5	1	2	2	2	3	3	2	2	2	2	3	3	2	3
Avg.	2.2	2.3	2	2.7	2.3	2.8	1.8	1.7	1.7	2	1.8	2.6	2.2	1.8

UNIT 1 **INTRODUCTION TO FOOD QUALITY CONCEPTS** **09**

Definition and importance of food quality – Food composition and nutritional quality – Major and minor food constituents – Objectives of food quality analysis – Types of food hazards – Quality attributes: appearance, texture, flavour, colour – Food quality regulations and BIS, FSSAI, Codex, ISO, AGMARK.

UNIT 2 **PHYSICAL AND CHEMICAL ANALYSIS OF FOOD** **09**

Sampling techniques – Determination of moisture, ash, fat, protein, fibre, carbohydrate – pH, titratable acidity, refractive index, specific gravity – Adulteration and detection techniques – Rapid analytical techniques – Shelf-life testing.

UNIT 3 **MICROBIAL AND TOXICOLOGICAL ANALYSIS** **09**

Microbial load determination – Standard Plate Count, MPN, Yeast and Mould count – Detection of foodborne pathogens – Mycotoxins and their analysis – Residue analysis: pesticides, antibiotics, heavy metals – Biosensor applications in detection.

UNIT 4 **QUALITY CONTROL SYSTEMS AND CERTIFICATION** **09**

Quality Assurance vs Quality Control – GMP, GHP, HACCP – Traceability and recall systems – Food safety management systems (FSMS) – ISO 22000, BRC, SQF, HALAL, KOSHER – Labeling standards and consumer safety.

UNIT 5 **INSTRUMENTAL TECHNIQUES IN FOOD QUALITY ANALYSIS** **09**

Spectrophotometry – Chromatography (HPLC, GC) – Electrophoresis – Texture analyzers – Hunter colorimeter – Viscometer – Differential Scanning Calorimetry (DSC) – Electronic nose and tongue – Image analysis systems.

TEXT BOOKS:

1 S.S. Khandpur, *Handbook of Analytical Instruments*, Tata McGraw Hill, 2017.
2 V.K. Joshi, *Food Quality and Safety*, ICAR Publications, 2019.

3 Y. H. Hui (Ed.), *Handbook of Food Science, Technology, and Engineering*, CRC Press, 2006.

REFERENCE BOOKS:

1 Ranganna, S., *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*, Tata McGraw-Hill, 2010.
2 Kirk, R.S. and Sawyer, R., *Pearson's Composition and Analysis of Foods*, Longman Scientific and Technical, 1991.
3 FSSAI Manuals (www.fssai.gov.in) for food testing protocols.
4 Jay, J.M., Loessner, M.J., and Golden, D.A., *Modern Food Microbiology*, Springer, 2005.

U23AGP17 ADVANCED TECHNOLOGIES IN FOOD PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Introduce novel and emerging food processing technologies.
2 Study the principles and applications of non-thermal and thermal processing.
3 Provide an understanding of automation, sensors, and control in food processing.
4 Familiarize with packaging innovations and intelligent food systems.
5 Understand sustainability and energy efficiency in advanced food processing

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Appreciate the need for advanced food processing technologies, food structure considerations, and shelf-life improvement strategies.
CO2: Explain the principles and mechanisms of non-thermal, thermal, and hybrid food processing techniques
CO3: Utilize advanced processing methods, automation tools, and sensors for improved product quality and process efficiency
CO4: Evaluate process performance, energy efficiency, microbial safety, and quality outcomes in advanced food processing systems.
CO5: Design sustainable and smart processing-packaging solutions incorporating automation, smart packaging, and zero-waste concepts.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	-	-	-	-	1	3	1	2
2	3	2	-	-	-	2	-	-	-	-	1	2	2	2
3	2	2	3	2	3	3	-	1	1	1	2	2	3	3
4	2	3	2	3	2	3	-	1	1	-	2	3	3	2
5	1	2	3	2	3	3	2	2	2	2	3	3	2	3
Avg.	2.2	2.2	2.7	2.3	2.7	2.6	2	1.3	1.3	1.5	1.8	2.6	2.2	2.4

UNIT 1 **INTRODUCTION TO ADVANCED FOOD PROCESSING** **09**

Need for advanced technologies – Limitations of conventional processing – Classification of novel food processing methods – Principles of food engineering and thermal transfer – Overview of food structure, stability, and shelf-life.

UNIT 2 **NON-THERMAL PROCESSING TECHNOLOGIES** **09**

Pulsed Electric Field (PEF), High Pressure Processing (HPP), Cold Plasma, Ultrasound, UV Radiation, Ozone treatment – Mechanism of microbial inactivation – Equipment and process parameters – Advantages, limitations, and applications in fruits, vegetables, dairy, and juices.

UNIT 3 **ADVANCED THERMAL AND HYBRID TECHNIQUES** **09**

Microwave, Ohmic Heating, Radio Frequency (RF) Heating, Infrared Heating – Microwave-assisted drying, freeze drying, vacuum drying – Extrusion cooking – Combination techniques (Thermal + Non-thermal) – Energy efficiency and product quality.

UNIT 4 **AUTOMATION, SENSORS AND PROCESS CONTROL** **09**

Role of automation in food industry – Types of sensors for temperature, pressure, viscosity, pH, moisture – SCADA, PLC and IoT integration – Real-time monitoring and feedback control systems – Digital twins in food process modeling.

UNIT 5 **SMART PACKAGING AND SUSTAINABLE PROCESSING** **09**

Intelligent and active packaging – Edible films and coatings – Nanotechnology in food packaging – Biodegradable and sustainable materials – Life Cycle Assessment (LCA) – Water and energy conservation – Zero-waste technologies.

TEXT BOOKS:

1 Gustavo V. Barbosa-Canovas et al., *Innovative Food Processing Technologies*, Woodhead Publishing, 2016.
2 Da-Wen Sun, *Emerging Technologies for Food Processing*, Academic Press, 2014.
3 Ramaswamy, H.S., and Marcotte, M., *Food Processing: Principles and Applications*, CRC Press, 2006.

REFERENCE BOOKS:

1 Ohlsson, T. and Bengtsson, N., *Minimal Processing Technologies in the Food Industry*, Woodhead Publishing, 2002.
2 Fellows, P., *Food Processing Technology: Principles and Practice*, Woodhead Publishing, 2017.
3 Jongen, W., *Food Supply Chain Management and Logistics*, Wiley, 2013.
4 Articles and reports from FSSAI, FAO, and Codex Alimentarius.

VERTICAL II - FARM MACHINERY AND ENERGY

		L	T	P	C
U23AGP21	**SPECIAL PRECISION FARM EQUIPMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Introduce the range and importance of precision implements for intercultural, spraying, harvesting, and post-harvest operations.
2 Explain working mechanisms, performance parameters, and selection criteria of various special purpose agricultural machines.
3 Enable students to apply knowledge in choosing, calibrating, and maintaining field machinery.
4 Develop analytical skills to evaluate and compare equipment performance under varying farm conditions.
5 Familiarize students with modern advancements in precision farming machinery and their practical utility.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and list the types, parts, and basic functions of specialized equipment used for weeding, mowing, spraying, threshing, and harvesting operations.
CO2: Explain the constructional features, working principles, and safety aspects of sprayers, harvesters, dusters, and post-harvest machinery.
CO3: Apply knowledge to select and calibrate appropriate equipment such as boom sprayers, pneumatic planters, or harvesters for specific crop and field conditions
CO4: Apply operational adjustments and maintenance practices for optimal use and lifespan of precision farm equipment under real-world scenarios.
CO5: Analyze the efficiency, performance factors, and suitability of specialized equipment used in precision farming and plantation crops.

CO-POMAPPING

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	1	-	-	-	-	1	3	1	-
2	3	2	-	-	-	3	-	-	-	-	1	2	2	-
3	2	2	3	-	2	2	-	-	-	1	2	2	3	2
4	2	3	-	2	2	3	1	1	-	2	2	3	3	2
5	1	3	2	3	3	3	1	1	2	2	3	3	2	3
Avg.	2.2	2.5	2.5	2.5	2.3	2.4	1	1	2	1.7	1.8	2.6	2.2	2.3

UNIT 1 **MOWERS AND WEEDING EQUIPMENT** **09**

Weeding and intercultural equipment. Junior hoe - guntaka - blade harrow - rotary weeders for upland and low land - selection, constructional features and adjustments - Spading machine – coir pith applicators - Mower mechanism – lawn mowers.

UNIT 2 **SPRAYERS AND DUSTERS** **09**

Sprayers – Sprayer operation – boom sprayer - precaution - coverage - factors affecting drift. Rotating disc sprayers – Controlled Droplet Application (CDA) - Aerial spraying – Air assist sprayers - orchard sprayers - Dusters - types - mist blower cum duster - care and

maintenance.

UNIT 3 **THRESHERS AND HARVESTERS** **09**

Construction and adjustments - registration and alignment. Windrowers, reapers, reaper binders and forage harvesters. Diggers for potato, groundnut and other tubers. Sugarcane harvesters - cotton pickers - corn harvesters - fruit crop harvesters – vegetable harvesters.

UNIT 4 **THRESHERS AND OTHER MACHINERIES** **09**

Thresher – construction and working of multi crop thresher. Forest machinery - shrub cutters - tree cutting machines – post hole diggers – Chaff cutter- flail mowers - lawn mowers – tree pruners

UNIT 5 **SPECIALIZED FARM EQUIPMENT** **09**

Pneumatic planters – air seeders – improved ploughs – seed and fertilizer broadcasting devices, manure spreaders, – direct paddy seeders, direct paddy cum daincha seeder, coconut tree climbing devices, tractor operated hoist, tractor operated rhizome planter - Balers.

TEXT BOOKS:

1 Zhang, Q. and Pierce, F.J. eds., 2013. Agricultural automation: fundamentals and practices. CRC Press.
2 Choudhury, A., Biswas, A., Singh, T.P. and Ghosh, S.K. eds., 2022. Smart Agriculture Automation Using Advanced Technologies: Data Analytics and Machine Learning, Cloud Architecture, Automation and IoT.

REFERENCE BOOKS:

1 National Research Council, Precision Agriculture in the 21st Century, National Academies Press, Canada, 1997
2 Young, S.L. and Pierce, F.J. eds., 2013. Automation: The future of weed control in cropping systems. Springer Science & Business Media.
3 Nof, S.Y. ed., 2009. Springer handbook of automation. Berlin, Heidelberg: Springer Berlin Heidelberg.

U23AGP22	**TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Introduce the need, policy framework, and system of testing farm machinery in Indi
2 Explain testing procedures, performance standards, and field/lab measurements for tractors, tillage, sowing, and harvesting equipment.
3 Familiarize students with performance evaluation of intercultural, spraying, and dusting equipment.
4 Develop skills to analyze combine harvester test data using standard protocols.
5 Understand and implement safety measures, test procedures, and regulatory norms for agricultural machinery

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and define testing terminology, standard parameters, and regulatory frameworks related to agricultural machinery evaluation.

CO2: Discuss procedures for lab and field testing of tractors, tillage implements, seeders, weeders, and pesticide application equipment.

CO3: Elucidate standardized testing protocols to evaluate PTO, drawbar, field efficiency, and calibration results of selected farm machinery.

CO4: Apply and assess safety testing methods (ROPS/FOPS), accident prevention strategies, and regulatory compliance measures.

CO5: Analyze test data from field observations and laboratory performance of combine harvesters and interpret key performance metrics.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	2	1	-	-	-	3	1	1
2	3	2	-	2	2	2	1	-	2	-	1	2	3	2
3	2	3	2	3	2	2	2	1	2	2	2	2	3	2
4	2	2	3	3	2	3	2	2	1	2	2	3	3	2
5	2	3	-	3	3	2	2	1	1	2	3	2	3	3
Avg.	2.4	2.5	2.5	2.8	2.3	2.2	1.8	1.3	1.5	2	1.8	2.4	2.6	2

UNIT 1 **TESTING OF AGRICULTURAL TRACTORS** **09**

Testing and evaluation system in India - Agricultural machinery situation - Mechanization policy – future prospects - standardization efforts - type of testing systems – General regulations - terminology- basic measurements, speed, fuel consumption, smoke density and power measurement - test items, specifications checking - PTO performance test- engine test, drawbar performance test - field test procedures -interpretation of results

UNIT 2 **TESTING OF TILLAGE AND SOWING EQUIPMENT** **09**

Testing of tillage machinery - laboratory test (hardness testing, chemical analysis) - field test (rate of work, quality of work, draft measurement, fuel consumption) - seed drill - laboratory test (seed drill calibration) - field checking and field tests.

UNIT 3 **TESTING OF INTERCULTURAL EQUIPMENT** **09**

Testing and evaluation of weeders - types of tests for weeder - types of pesticide application equipment - terminology - types of tests for sprayers - testing methods - types of test for duster - testing methods

UNIT 4 **TESTING OF COMBINE HARVESTER** **09**

Types of grain combines - combine systems - test items - procedure for laboratory testing - materials for field test - observations during field tests - sample analysis- data analysis - summary of performance parameters - analysis of field test data

UNIT	SAFETY TESTING OF AGRICULTURAL MACHINERY	09
5	Types of agricultural machinery accidents - causes of agricultural machinery accidents - technical| measurements for ensuring safety - methods of safety testing- ROPS and FOPS -safety precautions	

TEXT BOOKS:

1. Metha M.L., SR.Verma, K Mishra and VK Sharma. 1995. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana
2. Indian Standards Test Codes related to tractors, power tillers and agricultural implements

REFERENCE BOOKS:

1. Anonymous. 1983. RNAM Test Codes & Procedures for Farm Machinery. Technical Series 12.
2. Nebraska Tractor Test Codes for Testing Tractors, Nebraska, USA.

U23AGP23	HUMAN ENGINEERING AND SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Provide foundational knowledge of ergonomics and human physiological limits in agricultural work.
2. Explore human physical and energy functions relevant to farm operations.
3. Enable students to analyze anthropometric data and apply it to farm tool/equipment design.
4. Study human movement patterns and energy expenditure for effective task planning.
5. Introduce safety acts, accident prevention methods, and safety gadgets used in agricultural machinery operations.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

- CO1: Recognize ergonomic principles, human metabolism and physiological functions related to agricultural work.
- CO2: Interpret energy expenditure patterns, workload limits and human movement characteristics in farm operations.
- CO3: Apply anthropometric data and physiological criteria for ergonomic tool and equipment design.
- CO4: Assess human performance, safety risks and fatigue associated with agricultural machines and operations
- CO5: Analyze ergonomic and safety interventions to improve efficiency, comfort and protection in agricultural workplaces.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	-	-	-	-	1	3	1	-
2	3	2	-	2	-	3	-	-	-	-	1	2	2	-
3	2	2	3	2	2	3	1	-	-	1	2	2	3	2
4	2	3	2	3	1	3	2	1	1	1	2	2	3	2
5	1	3	3	3	2	3	2	2	2	2	3	3	2	3
Avg.	2.2	2.5	2.7	2.5	1.7	2.8	1.7	1.5	1.5	1.3	1.8	2.4	2.2	2.3

UNIT 1 **ERGONOMICS** **09**

Ergonomics- introduction- Role of ergonomics in Agriculture - Human metabolism- energy liberation in human body- Types of human metabolism- energy requirements at work - acceptable work load.

UNIT 2 **PHYSIOLOGICAL FUNCTIONS** **09**

Physical functions - Age and individual differences in physical functions- Physiological and operational criteria of physical activity.

UNIT 3 **ENERGY EXPENDITURE** **09**

Energy expenditure of activities-keeping energy expenditure within bounds- Energy expenditure of Spraying-Weeding operations - Movements of body members- Strength and endurance of movements - Movement of body members related to Agricultural activities - Speed and accuracy of movements - Time and distance of movements - Reaction time

UNIT 4 **ANTHROPOMETRY** **09**

Anthropometry – introduction- Types of data- Principles of applied anthrophometry - concept of percentile – Normal distribution – Estimating the range – Minimum and Maximum dimensions- Cost benefit analysis - applications of anthropometric data. Anthropometric consideration in tool / equipment design.

UNIT 5 **HUMAN SAFETY** **09**

Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

TEXT BOOKS:

1 Ernest and Mc Cormick, E.L. (1970). Human factors in engineering and design. Mc Graw Hill Co., New York.
2 Grandjean, E. (1988). Fitting the task to the man. Taylor and Francis, London.
3 Liljedhal, J.B, Carleton, W.M, Smith, P.K and David, M. (1978). Tractors and power units. John Wiley and sons, New York.
4 Murrel, K.H.F. (1978). Ergonomics, Man in his working environment. Chapman and Hall, London.

REFERENCE BOOKS:

1 Astrand, O.P and Rodhal, J. (1977). Work Physiology. Mc Graw hill Co. New York.

U23AGP24 MECHANICS OF TILLAGE AND TRACTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To understand the fundamental concepts of soil mechanics related to tillage.
2 To study the design and working of various tillage implements.
3 To analyze traction mechanics and soil-implement interaction.
4 To evaluate the performance of different traction systems under varied field conditions.
5 To optimize power transmission and traction efficiency in field operations.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recognize ergonomic principles, human metabolism and physiological functions related to agricultural work.
CO2: Interpret energy expenditure patterns, workload limits and human movement characteristics in farm operations.
CO3: Apply anthropometric data and physiological criteria for ergonomic tool and equipment design.
CO4: Assess human performance, safety risks and fatigue associated with agricultural machines and operations
CO5: Analyze ergonomic and safety interventions to improve efficiency, comfort and protection in agricultural workplaces.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	-	-	-	-	1	3	1	-
2	3	2	-	2	-	3	-	-	-	-	1	2	2	-
3	2	2	3	2	2	3	1	-	-	1	2	2	3	2
4	2	3	2	3	1	3	2	1	1	1	2	2	3	2
5	1	3	3	3	2	3	2	2	2	2	3	3	2	3
Avg.	2.2	2.5	2.7	2.5	1.7	2.8	1.7	1.5	1.5	1.3	1.8	2.4	2.2	2.3

UNIT 1 INTRODUCTION TO TILLAGE AND SOIL MECHANICS 09

Objectives and types of tillage: primary, secondary, and inter-tillage - Soil properties affecting tillage: cohesion, adhesion, texture, bulk density, porosity- Stress-strain relationship in soil, soil compaction and shear strength - Index of workability and tilth.

UNIT 2 TILLAGE IMPLEMENTS AND FORCE ANALYSIS 09

Traction efficiency, slip, pull, and drawbar power - Soil reaction – rolling resistance,

coefficient of traction - Traction mechanics: types of traction devices (wheels, tracks, lugs) - Soil compaction due to tractor traffic.

UNIT 3 **TRACTION FUNDAMENTALS AND SOIL-VEHICLE INTERACTION** **09**

Traction efficiency, slip, pull, and drawbar power - Soil reaction – rolling resistance, coefficient of traction - Traction mechanics: types of traction devices (wheels, tracks, lugs) - Soil compaction due to tractor traffic.

UNIT 4 **TRACTOR DYNAMICS AND POWER TRANSMISSION** **09**

Stability of tractor in different terrains (slope, wetland, etc.) - Weight transfer, load distribution and axle load calculation - Power transmission systems – mechanical and hydraulic - Ballasting and matching of tractor and implement.

UNIT 5 **FIELD PERFORMANCE AND TRACTION AIDING SYSTEMS** **09**

Field capacity and field efficiency - Traction aids: dual wheels, four-wheel drive, differential lock - Use of sensors and automation in traction systems - Economics and energy considerations in traction and tillage systems.

TEXT BOOKS:

1 Sahay, J., *Elements of Agricultural Engineering*, Standard Publishers.
2 Liljedahl, J.B. et al., *Tractor and Their Power Units*, CBS Publishers.

REFERENCE BOOKS:

1 Kepner, R.A., et al., *Principles of Farm Machinery*, CBS Publishers.
2 IS Codes for tillage and traction testing.

U23AGP25 **BIO ENERGY RESOURCE TECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To understand the types, availability, and characteristics of bio-energy resources derived from agricultural, forest, and industrial biomass.
2 To analyze the principles and processes involved in the conversion of biomass into useful energy forms such as biogas, biofuels, bio-oil, and bio-char.
3 To evaluate bio-energy technologies including anaerobic digestion, gasification, pyrolysis, and fermentation for efficient energy recovery.
4 To apply engineering concepts in the design, operation, and performance assessment of bio-energy systems and equipment.
5 To assess the environmental, economic, and sustainability aspects of bio-energy resource utilization in rural and industrial energy systems.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Outline bio-resource origins, biomass characteristics and fundamental bio-energy conversion concepts.
CO2: Clarify biogas production processes, bioenergetics, biocatalysis and slurry utilization practices.

CO3: Operate bio-reactors, fermenters and biomass conversion systems for energy and product generation.

CO4: Examine biochemical and thermochemical pathways involved in alcohol production, gasification and waste treatment

CO5: Recommend sustainable bio-energy systems considering environmental impact, co-generation and energy policy.

CO-POMAPPING

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	2	-	-	-	-	1	3	-	-
2	3	2	-	-	-	3	-	-	-	-	1	2	2	-
3	2	2	3	2	2	3	-	1	-	1	2	2	3	2
4	2	3	2	3	2	3	1	1	-	1	2	3	3	2
5	1	3	3	3	3	3	2	2	2	2	3	3	2	3
Avg.	2.2	2.5	2.7	2.7	2.3	2.8	1.5	1.3	2	1.3	1.8	2.6	2.5	2.3

UNIT 1 **UNIT I - BIO RESOURCE - AN INTRODUCTION** **09**

Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.

UNIT 2 **UNIT II - BIO ENERGY** **09**

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation

UNIT 3 **UNIT III - BIO REACTORS AND FERMENTORS** **09**

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Downstream processing-Recovery and purification of products.

UNIT 4 **UNIT IV - ALCOHOL PRODUCTION** **09**

Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibiotics- enzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers.

UNIT 5 **UNIT V - ENERGY AND ENVIRONMENT** **09**

Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – – Bioenergy policy.

TEXT BOOKS:

1 Rai G.D, Non conventional sources of Energy, Khanna publishers, New Delhi, 1995

2 Bouley James . E & David Follis- Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986

REFERENCE BOOKS:

1 Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986

U23AGP26	**AGRICULTURAL WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To recognize the types, sources, and impacts of agricultural waste.
2 To explain methods of handling, storing, and treating waste.
3 To apply waste conversion methods for productive use.
4 To analyze and evaluate appropriate waste utilization strategies for farms.
5 To plan environmentally sound waste management systems at farm and industry levels.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify the types and sources of agricultural waste and related issues.
CO2: Explain the methods of waste collection, storage, and safe handling.
CO3: Apply appropriate treatment and conversion technologies for agri-waste.
CO4: Analyze the utilization potential of agricultural waste for value addition.
CO5: Evaluate waste management planning and policies for sustainable farming.

CO-POMAPPING

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	1	1
2	3	2	-	-	-	3	-	-	-	-	1	2	2	1
3	2	2	3	2	2	3	-	1	1	1	2	3	3	3
4	2	3	2	3	-	3	-	1	1	-	2	2	2	2
5	1	2	3	2	2	3	2	2	2	2	3	3	3	3
Avg.	2.2	2.2	2.7	2.3	2	3	2	1.3	1.3	1.5	1.8	2.6	2.2	2

UNIT 1 **INTRODUCTION TO AGRICULTURAL WASTE** **09**

Types and classification: solid, liquid, gaseous wastes - Sources: crop residues, livestock waste, agro-industrial by-products - Properties and environmental impacts - Need for agricultural waste management.

UNIT 2 **WASTE COLLECTION, HANDLING, AND STORAGE** **09**

Methods of on-farm collection and segregation - Temporary and long-term storage of waste - Manual vs. mechanized handling - Health, hygiene and safety measures.

UNIT 3 **TREATMENT AND DISPOSAL TECHNIQUES** **09**

Composting (aerobic, anaerobic), vermicomposting - Biogas generation: process, factors,

design basics - Pyrolysis, incineration, lagoons, land application- Treatment of slurry and liquid waste.

UNIT 4 **UTILIZATION OF AGRICULTURAL WASTE** **09**

Organic manure preparation and application - Use of waste in mushroom farming, fish ponds, biochar - Renewable energy from waste: briquetting, biogas - Circular economy in agriculture.

UNIT 5 **POLICY, PLANNING AND ECONOMICS** **09**

Waste management hierarchy - National and state-level policies (SWM rules, CPCB guidelines) - Economic viability and subsidy schemes - Planning farm-level integrated waste systems.

TEXT BOOKS:

1 Ghosh S.N., *Agricultural Waste Management*, ICAR.
2 Yadav R., *Organic Waste Composting*, NIPA.

REFERENCE BOOKS:

1 Pichtel J., *Waste Management Practices*, CRC Press.

U23AGP27	**SOLAR AND WIND ENERGY SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To explain the basic principles of solar and wind energy availability.
2 To study the technologies and components used in solar and wind energy systems.
3 To explore hybrid and alternative energy sources like tidal, OTEC, geothermal, and fuel cells.
4 To analyze the design, performance, and applications of renewable systems in agriculture.
5 To promote sustainable and environmentally friendly energy practices in rural settings.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify solar and wind energy sources and measurement techniques
CO2: Explain energy conversion principles and system components used in solar and wind energy systems
CO3: Apply renewable energy technologies to agriculture and rural applications
CO4: Analyze system design and performance parameters for solar and wind energy applications
CO5: Inference the suitability of alternate energy systems for agriculture based on technical criteria

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	1	1
2	3	2	-	-	-	3	-	-	-	-	1	2	2	1
3	2	2	3	2	2	3	-	1	1	1	2	3	3	3
4	2	3	2	3	-	3	-	1	1	-	2	2	2	2
5	1	2	3	2	2	3	2	2	2	2	3	3	3	3
Avg.	2.2	2.2	2.7	2.3	2	3	2	1.3	1.3	1.5	1.8	2.6	2.2	2

UNIT 1 **SOLAR RADIATION BASICS AND MEASUREMENTS** **09**

Earth–Sun geometry, solar angles and declination - solar radiation types and components (direct, diffuse, global) - measurement devices: pyranometer, sunshine recorder, pyrheliometer - Solar radiation estimation and availability in India - applications in agriculture: greenhouses, solar dryers

UNIT 2 **SOLAR ENERGY CONVERSION SYSTEMS** **09**

Solar thermal systems: flat plate and concentrating collectors - solar PV systems: basic principles, types of modules, inverters, batteries - solar pumping systems – design and performance - agricultural applications: irrigation, drying, greenhouse heating - integration with microgrids and storage

UNIT 3 **WIND RESOURCE AND ENERGY CONVERSION** **09**

Wind energy fundamentals, wind profiles, wind mapping - wind turbines: components, aerodynamics, types (HAWT, VAWT) - Performance characteristics – power coefficient, tip speed ratio - wind energy potential and assessment - agricultural applications: water pumping, threshing, lighting

UNIT 4 **WIND ENERGY SYSTEM AND PERFORMANCE** **09**

Site selection and wind speed analysis - System sizing, hybrid systems (wind–diesel, wind–solar) - Wind energy economics and environmental impact - Battery storage and power conditioning - Case studies on wind energy in rural India.

UNIT 5 **ALTERNATIVE ENERGY SOURCES AND STORAGE SYSTEMS** **09**

Tidal, wave, and Ocean Thermal Energy Conversion (OTEC)-geothermal energy and its agricultural applications - hydrogen production, fuel cells – working principles - Biomass gasifiers and digesters - energy storage systems: batteries, thermal storage, flywheels.

TEXT BOOKS:

1 Rai G.D., *Non-Conventional Energy Sources*, Khanna Publishers
2 S.P. Sukhatme and J.K. Nayak, *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw Hill
3 D. Yogi Goswami, *Energy Efficiency and Renewable Energy Handbook*, CRC Press

REFERENCE BOOKS:

1 Tiwari G.N., *Solar Energy: Fundamentals, Design, Modeling and Applications*, Narosa Publishing

2 Manwell J.F., McGowan J.G., Rogers A.L., *Wind Energy Explained*, Wiley

3 Chetan Singh Solanki, *Solar Photovoltaics: Fundamentals, Technologies and Applications*, PHI

VERTICAL III - WATER MANAGEMENT AND PROTECTED CULTIVATION

U23AGP31 GROUNDWATER AND WELL ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To understand the occurrence, movement, and storage of groundwater in different hydrogeological formations.
2 To analyze the principles of groundwater flow, aquifer properties, and well hydraulics.
3 To evaluate methods of groundwater exploration, well design, construction, and development.
4 To apply pumping test data and analytical methods to determine aquifer characteristics and well performance.
5 To assess groundwater quality, contamination issues, and appropriate management strategies.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and outline groundwater concepts, aquifer properties, well types, recharge methods and quality issues.
CO2: Describe groundwater flow behavior, aquifer response, well hydraulics and pollution mechanisms.
CO3: Apply pumping tests, flow equations and design principles for wells and groundwater systems.
CO4: Examine groundwater data, well performance, recharge options and management interventions.
CO5: Assess groundwater development strategies considering sustainability, risk and regulatory aspects.

CO-PO MAPPING

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	-	-	-	-	3	-	-	-	-	-	3	-	-
2	3	2	-	-	-	3	-	-	-	-	-	-	2	-
3	3	-	3	-	2	-	-	-	-	-	-	3	-	3
4	-	3	-	3	-	3	-	-	-	-	-	3	-	-
5	-	-	-	-	-	2	-	-	-	3	-	-	-	3
Avg.	3	2.5	3	3	2	2.75	-	-	-	3	-	3	2	3

UNIT 1 GROUNDWATER OCCURRENCE **09**

Distribution of subsurface water – Water bearing properties of Rocks – Types of Aquifers – Aquifer properties, Pumping test, Methods of Groundwater Estimation, Ground water development and potential in India, Geophysical techniques of Groundwater Estimation.

UNIT 2 WELL DESIGN AND HYDRAULICS **09**

Darcy's law – Groundwater Flow Equation, Steady state flow – Dupuit Forcheimer Assumption – Theim's Equationtypes of water wells, design and construction of water

wells, drilling methods, well development, well maintenance and rehabilitation, groundwater monitoring, monitoring wells, design and construction of monitoring wells

UNIT 3 **GROUNDWATER POLLUTION** **09**

Groundwater development and quality considerations, groundwater contamination, sources and causes of groundwater pollution, contaminated systems and their rehabilitation, groundwater bioremediation, management of salt water ingress in inland and coastal aquifers.

UNIT 4 **GROUNDWATER MANAGEMENT** **09**

Management of declining and rising water table, Natural and artificial groundwater recharge, Groundwater recharge basins and injection wells. Groundwater management in irrigation command, conjunctive water use, water lifting, different types of pumps, selection of pumps, pump characteristics curve, cost of groundwater pumping, comparative economics of surface and groundwater use for irrigation

UNIT 5 **GROUNDWATER DEVELOPMENT POLICIES** **09**

Major issues related to groundwater development and management in India, Legal aspects of groundwater exploitation, Diagnostic survey of sick wells/tube wells and their rehabilitation.

TEXT BOOKS:

1 Walton, W.C. 1976. Groundwater Resource Evaluation. Mc Graw Hill. New York.
2 Karanth, K.R. 1987. Groundwater Assessment, Development and Management. Tata-mcgraw Hill. New Delhi.
3 Michael, A.M. and Khepar, S.D. 1989. Water Well and Pump Engineering. Tata-mcgraw Hill Publ. Co. New Delhi.

REFERENCE BOOKS:

1 Giordano, M. and Villholth, K.G. 2007. The Agricultural Groundwater Revolution Volume 3.
2 CABI Head Office, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, UK Ghosh, N.C. and Sharma, K.D. 2006. Groundwater Modelling and Management.
3 Madan Kumar Jha and Stefan Peiffer Applications of Remote Sensing and GIS Technologies in Groundwater Hydrology: Past, Present and Future

U23AGP32 **COMMAND AREA DEVELOPMENT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To understand the concept, objectives, and components of command area development in irrigation projects.
2 To analyze irrigation water management practices for efficient utilization of surface and groundwater resources within command areas.
3 To evaluate land development, canal lining, and drainage systems for improving irrigation efficiency and agricultural productivity.
4 To apply principles of conjunctive water use, cropping pattern planning, and on-farm water management.
5 To assess the socio-economic, environmental, and sustainability impacts of command area development programmes.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall concepts, terminology, institutions and policies related to command area development and water management.

CO2: Interpret water resources, S practices, soil issues and socio-economic aspects in command areas

CO3: Apply irrigation scheduling, water allocation, conservation and reclamation techniques in command areas

CO4: Analyze water distribution performance, soil degradation problems and management interventions using technical and spatial tools

CO5: Assess command area development projects considering sustainability, farmer participation and policy effectiveness.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	1	1
2	3	2	-	-	-	3	-	-	-	-	1	2	2	1
3	2	2	3	2	2	3	-	1	1	1	2	3	3	3
4	2	3	2	3	3	3	-	1	1	-	2	2	2	2
5	1	2	3	2	2	3	2	2	2	2	3	3	3	3
Avg.	2.2	2.2	2.7	2.3	2.3	3	2	1.3	1.3	1.5	1.8	2.6	2.2	2

UNIT 1 INTRODUCTION **09**

Concept, need and objectives of CAD - Historical background and evolution of CAD in India- Components of command area development projects- Institutional setup for CAD- Command area vs. cultivable command area (CCA). Challenges in Command area – success stories of CAD in India.

UNIT 2 WATER RESOURCE MANAGEMENT **09**

Water resources of India and Tamil Nadu - Principles of water resource management in CAD - Water allocation and distribution systems - Water balance studies and water budgeting - Water conservation and efficient use of water

UNIT 3 WATER MANAGEMENT IN COMMAND AREAS **09**

Irrigation scheduling and rotational water supply (Warabandi) - Canal operation plans and water distribution - Measurement of irrigation water- On-farm development works: field channels, field drains- Use of micro-irrigation and pressurized irrigation system.

UNIT 4 RECLAMATION OF DEGRADED SOIL **09**

Role of conjunctive use of surface and groundwater - Land reclamation in saline/alkaline soils. Methods of salinity and waterlogging control - Improving soil productivity in command areas. Use of remote sensing techniques for command area development; case studies of some selected commands;

UNIT 5 SOCIO-ECONOMIC AND INSTITUTIONAL ASPECTS **09**

Farmer's participation in command area development. Modernization of Command Area

Development and Water Management Scheme. Participatory irrigation management (PIM)

Water Users Associations (WUAs): formation and functions. Impact of CAD on crop yield, employment, and income - Performance evaluation of CAD projects - Government schemes and policy initiatives.

TEXT BOOKS:

1 Punmia, B.C and Pande, B.B. (1999). Irrigation and Water Power Engg. Standard Publishers and Distributors, New Delhi.
2 Hoffman, G.J., Howell, T.A and Soloman, K.N. (1990). Management of Farm Irrigation System. ASAE.
3 Michael, A. M. (1990). Irrigation Theory and Practice. Vani Educational Books
4 Modi, P. N. (1995). Irrigation Water Resources and Water Power Engineering. Std Book House, New Delhi.

REFERENCE BOOKS:

1 Murthy, C.S. (1990). Design of Minor irrigation and canal structures. Wiley eastern Limited, New Delhi.
2 Murthy, V.V.N. (1998). Land and Water Management. Kalyani Publishing, New Delhi
Proc. of seminar on water Management. (1992). Vol 1 & II. Water Management Forum, Gandhinagar.

U23AGP33	**DESIGN OF MICRO-IRRIGATION SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To understand the principles, components, and advantages of micro irrigation systems such as drip and sprinkler irrigation.
2 To analyze crop water requirements, soil characteristics, and climatic factors for planning micro irrigation systems.
3 To design drip and sprinkler irrigation systems including layout, hydraulic calculations, and system components.
4 To evaluate the performance, efficiency, and uniformity of micro irrigation systems under field conditions.
5 To apply operation, maintenance, and management practices for improving water-use efficiency and sustainability in micro irrigation systems

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify principles, components, standards and application areas of micro irrigation systems.
CO2: Interpret hydraulic behavior, wetting characteristics, fertigation practices, automation concepts and economic terms in micro irrigation.
CO3: Demonstrate design and layout preparation of drip and sprinkler irrigation systems for field conditions
CO4: Examine system performance, quality compliance, operational issues and cost effectiveness of micro irrigation systems

CO5: Appraise micro irrigation projects considering automation level, crop suitability, financial feasibility and sustainability.

CO-PO MAPPING

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	-	1
2	3	2	-	-	1	3	-	-	-	-	1	2	2	2
3	2	2	3	-	2	3	1	1	1	1	2	3	3	3
4	1	3	2	3	-	3	1	1	-	2	2	2	2	2
5	1	2	3	2	2	3	2	2	2	3	3	3	3	3
Avg.	2	2.25	2.7	2.5	1.7	3	1.3	1.3	1.5	2	1.8	2.6	2.5	2.2

UNIT 1 **MICRO IRRIGATION CONCEPT AND APPLICATIONS** **09**

Micro irrigation -Merits, demerits, types and components of micro irrigation system- Present status, Scope and potential problem of micro irrigation - Micro-irrigation applications: Hills, arid lands, coastal and wastelands, Financial Assistance for Promotion of Micro Irrigation in India.

UNIT 2 **DRIP IRRIGATION DESIGN** **09**

Drip irrigation - Components- Dripper- types and equations governing flow through drippers- Wetting pattern- Chemigation application- Pump capacity -Installation- Operation and maintenance of Drip irrigation system. - Design of surface and sub-surface drip irrigation.

UNIT 3 **SPRINKLER IRRIGATION DESIGN** **09**

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation - System maintenance

UNIT 4 **ECONOMIC ANALYSIS** **09**

Standardization and Quality Assurance of Micro Irrigation System Components. Terminologies in Economic Analysis, Optimal Flow Criterion for Economic Drip Irrigation Pipes Selection, Economic Viability of Micro Irrigation in Different Crops

UNIT 5 **AUTOMATION IN MICRO IRRIGATION** **09**

Automation, Need for Automation of Irrigation, Merits and Demerits of Automation, Semiautomatic and Fully Automatic Systems of Automation, Components of Automation System, Types of Controls and Automation in Micro Irrigation.

Project preparations: Design and draw the layout of a drip/sprinkler irrigation system for 10 acres, preparation of project proposal for the installation and commissioning of irrigation systems

TEXT BOOKS:

1 Suresh, R., “Principles of Micro-Irrigation Engineering”, Standard Publishers Distributors, New Delhi, 2010.

2 Michael, A.M., "Irrigation Theory and Practice", Vikas Publishers, New Delhi, 2002.

REFERENCE BOOKS:

1 Modi, P.N., and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 1991.
2 Jack Keller and Rond Belisher., "Sprinkler and Trickle Irrigation", Vannistrand Reinhold, New York, 1990.
3 Sivanappan R.K., "Sprinkler Irrigation", Oxford and IBH Publishing Co., New Delhi, 1987.
4 Keller.J and D. Karmeli, "Trickle Irrigation Design", Rainbird sprinkler Irrigation anufacturing Corporation, Glendora, California, USA.

U23AGP34 PROTECTED CULTIVATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Understand the importance and types of protected cultivation structures and systems.
2 Acquire knowledge on hi-tech protected cultivation techniques for vegetables and flowers.
3 Learn about integrated crop management practices in controlled environments.
4 Apply precision farming tools including GIS, GPS, and remote sensing in horticultural crop production.
5 Analyze precision farming practices for various horticultural crops using digital and automated systems.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recall and understand the significance, structures, and components of protected cultivation systems.
CO2: Apply precision farming concepts including GIS, GPS, and sensor-based
CO3: Apply protected cultivation techniques and integrated management practices in vegetable and flower crops.
CO4: Analyze environmental, irrigation, and nutrient factors in controlled structures for optimized crop performance monitoring in horticultural systems.
CO5: Analyze crop-specific precision farming techniques for various horticultural crops using advanced tools and automation.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	-	1
2	2	2	-	-	3	3	-	1	1	-	2	2	3	3
3	2	2	3	-	2	3	1	2	1	1	2	3	2	2
4	1	3	2	3	-	3	-	1	-	2	2	2	2	2
5	1	2	3	2	3	3	2	2	2	3	3	3	3	3
Avg.	1.8	2.25	2.7	2.5	2.7	3	1.3	1.4	1.3	2	2	2.6	2.5	2.2

UNIT 1 **PROTECTED CULTIVATION AND ITS TYPES** **09**

Importance and methods of protected culture in horticultural crops. Importance and scope of protected cultivation, different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house. Study of environmental factors influencing green house production, cladding / glazing / covering material, ventilation systems, cultivation systems including nutrient film technique / hydroponics / aeroponic culture, growing media and nutrients, canopy management, micro irrigation and fertigation systems.

UNIT 2 **PROTECTED CULTIVATION OF VEGETABLE CROPS** **09**

Protected cultivation technology for vegetable crops: Hi-tech protected cultivation techniques for tomato, capsicum nursery, cucumber, gherkins strawberry and melons, integrated pest and disease management, post harvest handling.

UNIT 3 **PROTECTED CULTIVATION OF FLOWER CROPS** **09**

Protected cultivation technology for flower crops: Hi-tech protected cultivation of cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers, integrated pest and disease management, postharvest handling.

UNIT 4 **PRECISION FARMING TECHNIQUES** **09**

Concept and introduction of precision Farming: importance, definition, principles and concepts. Role of GIS and GPS. Mobile mapping system and its application in precision farming. Design, layout and installation of drip and fertigation in horticultural crops, role of commuters in developing comprehensive systems needed in site specific management (SSM), georeferencing and photometric correction. Sensors for information gathering, geostatistics, robotics in horticulture, postharvest process management (PPM), remote sensing, information and data management and crop growth models, GIS based modeling,VRT, robotics and drones in agriculture

UNIT 5 **PRECISION FARMING FOR HORTICULTURAL CROPS** **09**

Precision farming techniques for horticultural crops: Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

TEXT BOOKS:

1 Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
2 Paul V. Nelson. 1991. Green house operation and management. Ball publishing USA.

REFERENCE BOOKS:

1 Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond. Mapping out world: GIS lessons for Education, ESRI press, 2002
2 David Reed, Water, media and nutrition for green house crops. Ball publishing USA, 1996
3 Adams, C.R. K.M. Bandford and M.P. Early, Principles of Horticulture, CBS publishers and distributors, Darya ganj, New Delhi, 1996
4 Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond. Mapping out world: GIS lessons for Education, ESRI press, 2002
5

U23AGP35	BASICS OF INTEGRATED WATER RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1 To introduce the interdisciplinary approach of water management.

2 To develop knowledge base and capacity building on IWRM.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recognize fundamental water facts, IWRM concepts, principles, global goals and institutional perspectives.

CO2: Interpret interactions among water use sectors, economic considerations and ecosystem requirements within IWRM.

CO3: Apply economic instruments, governance approaches and sectoral strategies for integrated water management

CO4: Diagnose water management challenges related to climate change, equity, sustainability and river basin systems

CO5: Analyze IWRM implementation strategies using policy frameworks, institutional reforms and real-world case studies.

CO-PO MAPPING

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	-	-	-	-	3	1	-	-	-	1	3	-	1
2	2	2	-	-	-	3	-	1	-	-	1	2	2	2
3	1	2	3	-	2	3	2	2	1	1	2	3	3	3
4	1	3	2	3	-	3	2	1	-	2	2	2	2	2
5	1	2	3	2	2	3	2	2	2	3	3	3	3	3
Avg.	1.6	2.25	2.7	2.5	2	3	1.8	1.5	1.5	2	1.8	2.6	2.5	2.2

UNIT 1 OVERVIEW OF IWRM **09**

Facts about water – Definition – Key challenges – Paradigm shift - Water management Principles – Social equity – Ecological sustainability – Economic efficiency – SDGs – World Water Forums.

UNIT 2 WATER USE SECTORS: IMPACTS AND SOLUTION **09**

Water users: People, Agriculture, ecosystem and others – Impacts of the water use sectors on water resources – Securing water for people, food production, ecosystems and other uses – IWRM relevance in water resources management.

UNIT 3 WATER ECONOMICS **09**

Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management – PPP experiences through case studies.

UNIT 4 **RECENT TREANDS IN WATER MANAGEMENT** **09**

Barriers to implementing IWRM – Policy and legal framework – Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

UNIT 5 **IMPLEMENTATION OF IWRM** **09**

Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TEXT BOOKS:

1 Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2 Mollinga P. *et al.* " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.

REFERENCE BOOKS:

1 Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.
2 IWRM Guidelines at River Basin Level (UNESCO, 2008).
3 Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrm/Tutorial _text.pdf
4 Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.
5 The 17 Goals, United Nations, https://sdgs.un.org/goals.

U23AGP36 **CLIMATE CHANGE AND ADAPTATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To know the basics, importance of global warming
2 To know the concept of mitigation measures against global warming
3 To learn about the global warming and climate change

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Enumerate climate system components, greenhouse gases, atmospheric structure and global biogeochemical cycles.
CO2: Explain climate change processes, atmospheric stability, radiative effects and sectoral impacts of global warming.
CO3: Apply climate concepts to interpret mitigation options, carbon mechanisms and adaptation measures.
CO4: Analyze observed and projected climate change impacts, feedback mechanisms and policy responses at global and national scales
CO5: Critique climate mitigation and adaptation strategies considering technological feasibility, sustainability and risk of irreversible change.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	-	1
2	3	2	-	-	-	3	-	-	-	-	2	2	2	1
3	2	2	2	-	2	3	1	1	1	1	2	3	2	3
4	2	3	2	3	-	3	1	1	-	2	2	2	3	2
5	1	2	3	2	2	3	2	2	2	3	3	3	3	3
Avg.	2.2	2.25	2.3	2.5	2	3	1.3	1.3	1.3	2	2	2.6	2.5	2

UNIT 1 **EARTH'S CLIMATE SYSTEM** **09**

Role of ozone in environment ozone layer ozone depleting gases Green House Effect, Radiative effects of Greenhouses Gases Hydrological Cycle Green House Gases and Global Warming Carbon Cycle

UNIT 2 **ATMOSPHERE AND ITS COMPONENTS** **09**

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere- Composition of the atmosphere Atmospheric stability- Temperature profile of the atmosphere - Lapse rates - Temperature inversion - effects of inversion on pollution dispersion

UNIT 3 **IMPACTS OF CLIMATE CHANGE** **09**

Causes of Climate change : Change of Temperature in the environment Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarios Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes.

UNIT 4 **CLIMATE CHANGES AND ITS CAUSES** **09**

Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.

UNIT 5 **CLIMATE CHANGE AND MITIGATION MEASURES** **09**

Biodiesel - Natural Compost - Eco-Friendly Plastic - Alternate Energy -Hydrogen - Bio-fuels - Solar Energy - Wind - Hydroelectric Power -Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices-Energy Supply - Transport - Buildings-Industry-Agriculture

TEXT BOOKS:

1 Sangam Shrestha, Mukand S. Babel and Vishnu Prasad Pandey, 2014, Climate Change and Water Resources, CRC Press an imprint of the Taylor & Francis Group.
2 Intergovernmental Panel on Climate Change: https://www.ipcc.ch/

REFERENCE BOOKS:

1 Adaptation and mitigation of climate Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006

2 Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006

3 Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes?, Cambridge University Press, 2003.

U23AGP37	**WATERSHED DEVELOPMENT AND MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To provide the technical know-how of analysing the degradation of soil and water resources and implementation of the measures for soil and water conservation.

2 To provide a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: List watershed concepts, characteristics, land capability classes and development programmes relevant to watershed management.

CO2: Interpret watershed behavior using hydrologic data, land use patterns, runoff processes and conservation principles.

CO3: Implement watershed planning, soil–water conservation measures and water harvesting practices for sustainable development.

CO4: Examine the effectiveness of watershed interventions, participatory approaches and conservation structures in different agro-ecological regions

CO5: Analyze watershed development strategies using economic analysis, monitoring tools, remote sensing and institutional frameworks.

CO-PO MAPPING

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	-	1
2	3	2	-	-	-	3	-	-	-	-	2	2	2	1
3	2	2	3	-	-	3	1	2	1	1	2	3	3	3
4	2	3	2	3	-	3	1	1	-	2	2	3	2	2
5	1	2	3	2	3	3	2	2	2	3	3	3	3	3
Avg.	2.2	2.25	2.7	2.5	3	3	1.3	1.5	1.3	2	2	3	2.5	2

UNIT 1 INTRODUCTION **09**

Watershed – Definition - concept - Objectives – Land capability classification - Watershed Based Land Use Planning-Watershed Characteristics: Classification and Measurement-priority watersheds - land resource regions in India- Importance of Watershed Properties for Watershed Management.

UNIT 2 WATERSHED PLANNING **09**

Importance of Watershed Planning - Utility of Hydrologic Data in Watershed Planning - Watershed Delineation - Planning principles – collection of data – present land use - Preparation of watershed development plan - Estimation of costs and benefits - Financial plan – selection of implementation agency - Monitoring and evaluation system

UNIT 3 **WATERSHED MANAGEMENT** **09**

Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands

UNIT 4 **WATER CONSERVATION PRACTICES** **09**

In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Micro catchment water harvesting - Ground water recharge – percolation ponds -Water harvesting Design of Water Harvesting Structures - Farm pond - Supplemental irrigation - Evaporation suppression - Seepage reduction

UNIT 5 **WATERSHED DEVELOPMENT PROGRAMME** **09**

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development.

TEXT BOOKS:

1 Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.
2 Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.

REFERENCE BOOKS:

1 Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi.
2 Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi
3 Tripathi R.P. and H.P.Singh 2002, Soil erosion and conservation, Willey Eastern Ltd., New Delhi
4 Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi
5 Tideman, E.M., “Watershed Management”, Omega Scientific Publishers, New Delhi, 1996.

VERTICAL IV - SUSTAINABLE AGRICULTURE AND MANAGEMENT

		L	T	P	C
U23AGP41	**INTEGRATED FARMING SYSTEM**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

1 Introduce the principles of Integrated Farming Systems (IFS) and highlight the role of resource recycling in enhancing sustainability and productivity in agricultural ecosystems.
2 Provide knowledge on the integration of crop, livestock (dairy/goat), biogas, mushroom, and silviculture components, emphasizing synergistic relationships and by-product utilization.
3 Familiarize students with organic waste management techniques, such as biogas production and vermicomposting, using farm residues for renewable energy and soil health.
4 Enable students to understand the structural and functional aspects of eco-friendly technologies, such as the Deenbandhu biogas plant and low-cost mushroom production units.
5 Develop the ability to analyse and design efficient IFS models, particularly for wetland and smallholder systems, focusing on circular nutrient flow and economic viability.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Outline farming system concepts, principles, components and resource linkages involved in integrated farming systems.
CO2: Interpret interactions among crops, livestock, allied enterprises and natural resources within integrated farming systems
CO3: Apply integrated farming practices including livestock management, agroforestry, aquaculture and organic inputs.
CO4: Analyze productivity, sustainability and resource-use efficiency of different integrated farming system models
CO5: Examine integrated farming system designs incorporating recycling, renewable energy and income diversification strategies.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	-	-	-	-	1	3	-	1
2	3	2	-	-	-	3	-	-	-	-	1	2	2	1
3	2	2	3	-	2	3	1	1	1	1	2	3	3	3
4	2	3	2	3	-	3	1	1	-	2	2	2	2	2
5	1	2	3	2	2	3	2	2	2	3	3	3	3	3
Avg.	2.2	2.25	2.7	2.5	2	3	1.3	1.3	1.3	2	1.8	2.6	2.5	2

UNIT 1 **INTRODUCTION OF FARMING SYSTEM** **09**

Farming system – introduction – scope of farming system – importance – concept – principles of farming system - Types of farming systems – Advantages and limitations - suitability – factors affecting the farming system.

UNIT 2 **INTEGRATED FARMING SYSTEM** **09**

Integrated farming system-historical background - objectives and characteristics advantages of IFS – Components of IFS - Integrated Farming System in Wetland – IFS in garden land –- IFS in dryland and fallow land

UNIT 3 **LIVESTOCK PRODUCTION IN IFS** **09**

IFS With Goats and Sheep – housing and feeding management – deworming – Young stock management - Dairy Farming in IFS - Fodder production in IFS - IFS With poultry rearing - Duck farming – Rabbit farming – Piggery

UNIT 4 **IFS COMPONENTS** **09**

Agroforestry – definition – types of agroforestry system – benefits of agroforestry system– Aquaculture – Fish cum agriculture and horticulture – Beekeeping – types and cast of bees – care and management in beekeeping – Sericulture - Mulberry cultivation – Silkworm rearing – Organic farming – Azolla – Small scale nursery

UNIT 5 **RESOURCE RECYCLING IN IFS** **09**

Resource recycling in wetland IFS - Resource flow in crop + dairy + biogas + spawn + silviculture In IFS - Biogas production through IFS – Resource recycling in crop + goat IFS - Uses and features of biogas - Structure and function of Dheenabandhu Gas plant - Vermicompost - Preparation of vermicompost from farm residue – Mushroom production in IFS.

TEXT BOOKS:

1 Nanda, Sankarsana. Integrated farming system practices: challenges and opportunities. New India Publishing Agency, 2016.
2 Ravikiran Vasant Mane, Integrated Farming System: A Strategy for Sustainable Farm Production & Livelihood Security, Scitus Academics, 2016

REFERENCE BOOKS:

1 Zaman, Integrated Farming System and Agricultural, New India Publishing Agency, 2019
2 Nanwal R. K. Farming System and Sustainable Agriculture, Kalyani Publishers, 2017

U23AGP42 AGRICULTURAL BUSINESS MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Understand the basics of agricultural business management, including management concepts, theories, functions, and their role in agribusiness.
2 Learn the principles and types of agri-business organizations and the application of managerial functions such as staffing, directing, motivation, and control.
3 Understand the major functional areas of agri-business, including production, operations, inventory, and marketing management.
4 Gain knowledge of agricultural business finance, including capital management, agricultural credit, sources of finance, and the role of NABARD.
5 Develop an understanding of market promotion and human resource practices in agribusiness, including pricing, distribution channels, market assessment, and personnel management.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Define agri-business concepts, organizational forms, marketing elements, financial terms and managerial functions.
CO2: Explain management practices, business operations, marketing systems, financial mechanisms and human resource processes in agri-business
CO3: Apply planning, marketing, budgeting, inventory control and project scheduling techniques in agri-business situations.
CO4: Analyse agri-business performance using SWOT analysis, ROI, market potential and control techniques
CO5: Evaluate agri-business strategies related to finance, promotion, technology adoption and organizational growth.

CO-POMAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	2	2	-	2	1	-	1	2	2	2	2	3	-	1
2	2	2	2	2	1	-	1	2	2	2	2	2	2	1
3	2	2	2	2	1	-	1	2	2	2	2	3	3	3
4	2	2	3	1	0	-	2	2	2	2	2	2	2	2
5	2	3	3	2	1	-	1	2	2	2	2	3	3	3
Avg.	2	2.2	2	1.8	0.8	-	1.2	2	2	2	2	2.6	2.5	2

UNIT 1 **CONCEPTS OF AGRICULTURAL BUSINESS** **09**

Agri-business - scope, characteristics, types. Management - importance, definition, management and administration, management thoughts – F.W. Taylor's Contribution to the management, Henri Fayol's 14 principles of management. Small business - characteristics and stages of growth - Management functions - planning, organizing, leading.

UNIT 2 **AGRI – BUSINESS ORGANIZATION** **09**

Principles, forms of agri-business organizations, staffing, directing, supervision and motivation. Controlling - types, performance evaluation and control techniques. Management approaches - Management by objectives and Quality Circles. Strength, Weakness, Opportunities and Threat (SWOT) Analysis.

UNIT 3 **AGRICULTURAL MARKETING** **09**

Functional areas of Agri-business - Production and Operations management - functions, planning physical facilities and managing quality. Agro-inputs and products inventory management - raw material procurement, inventory types, and costs. Marketing management - Marketing environment, marketing mix.

UNIT 4 **AGRICULTURAL BUSINESS FINANCE** **09**

Financial Management- Fixed capital & Working capital – Definition of Agricultural Credit - Sources of Agricultural Finance - Classification of Agricultural credit - Rural credit: Types of Rural Credits - Role of NABARD in Agribusiness Finance - Problems Associated with Agricultural Finance - Suggestions to Improve Agricultural Finance - launching products (branding, placement).

UNIT **MARKET PROMOTION AND HUMAN RESOURCES** **09**

5 Agricultural products - marketing promotion activities - product pricing methods. District Industries Centre - Consumer survey - Agricultural inputs retailing - Market potential assessment - types of distribution channels - Return on Investment - Personnel management. Recruitment, selection and training.

TEXT BOOKS:

1 Himanshu, "Agri Business Management – Problems and prospects", Ritu Publications, Jaipur, 2005.
2 Smita Diwase, "Indian Agriculture and Agribusiness Management", Krishi resource Management Network, Pune 2004.

REFERENCE BOOKS:

1 Chandra Prasanna, "Projects: Preparation, Appraisal, Budgeting and Implementation", Tata McGraw Hill Publications, New Delhi, 2001.
2 Kotler, P., "Marketing Management. Analysis, Planning and Control", Prentice Hall Inc., New York, 2001.
3 Rao, V.S.P., and Narayana, P.S., "Principles and Practices of Management", Konark Publishing Private Limited, New Delhi, 2001.
4 Tripathy, P.C., and Reddy, P.N., "Principles of Management", Tata McGraw HillPublications, New Delhi, 2000.

U23AGP43	**SUSTAINABLE AGRICULTURE AND FOOD SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To understand the concepts and principles of sustainable agriculture and their role in ensuring food security.
2 To analyze the interactions among soil, water, crops, climate, and biodiversity in sustainable farming systems.
3 To evaluate sustainable agricultural practices and technologies for enhancing productivity, resilience, and resource-use efficiency.
4 To assess food security dimensions including availability, access, utilization, and stability in local and global contexts.
5 To promote environmentally sound, economically viable, and socially equitable strategies for sustainable agriculture and food systems

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify land, water, food and policy-related components influencing agricultural sustainability and food security.
CO2: Interpret relationships among land use, water availability, climate variability, cropping systems and food production trends.
CO3: Apply principles of sustainable agriculture, organic farming, rainfed farming and resource-use efficiency to real-world farming systems
CO4: Analyze food production performance, resource degradation, productivity decline, market forces and sustainability indicators
CO5: Examine agricultural policies, food security programmes, virtual water trade and sustainability action plans for long-term development

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	1	-	-	-	2	3	-	1
2	2	2	-	-	-	3	-	-	-	-	2	2	2	1
3	2	2	3	-	2	3	2	2	1	1	2	3	3	3
4	2	3	2	3	-	3	2	1	-	2	2	2	2	2
5	1	2	3	2	2	3	3	3	3	3	3	3	3	3
Avg.	2	2.25	2.7	2.5	2	3	2	2	1.7	2	2.2	2.6	2.5	2

UNIT 1 **UNIT I - LAND RESOURCE AND ITS SUSTAINABILITY** **09**

Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation

UNIT 2 **UNIT II - WATER RESOURCE AND ITS SUSTAINABILITY** **09**

Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Ground water & Surface water)

UNIT 3 **UNIT III - SUSTAINABLE AGRICULTURE & ORGANIC FARMING** **09**

Agro-ecosystems - Impact of climate change on Agriculture, Effect on crop yield, and effect on Soil fertility – Food grain production at State Level – Indicators of Sustainable food availability – Indicators of food production sustenance – Natural farming principles – Sustainability in rainfed farming – organic farming – principles and practices.

UNIT 4 **UNIT IV - FOOD PRODUCTION AND FOOD SECURITY** **09**

Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of market force – Rural Land Market – Emerging Water market – Vertical farming - Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development.

UNIT 5 **UNIT V - POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY** **09**

Food and Crop Production polices – Agricultural credit Policy – Crop insurance –Policies of Natural Resources Use – Policies for sustainable Livelihoods – Virtual water and trade - Sustainable food Security Action Plan.

TEXT BOOKS:

1 B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India Publishing Agency, New Delhi, 2007

2 Saroja Raman, Agricultural Sustainability– Principles, Processes and Prospects, CRC Press, 2013

REFERENCE BOOKS:

1 Swarna S.Vepa etal., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2 Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999
3 Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
4 M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.

U23AGP44 RURAL AND ENVIRONMENTAL ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 To understand the principles of rural infrastructure planning and environmental engineering systems.
2 To analyze rural water supply, sanitation, waste management, and drainage systems.
3 To evaluate environmental pollution issues and appropriate control and treatment technologies.
4 To apply engineering solutions for sustainable rural development and environmental protection.
5 To assess the environmental, social, and sustainability impacts of rural and environmental engineering projects

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recognize the interactions between human activities, socio-economic factors, occupational exposure and environmental pollution.
CO2: Explain the origin, classification and behavior of air and water pollutants under varying climatic and meteorological conditions
CO3: Demonstrate appropriate techniques for sampling, measuring and interpreting air and water quality parameters using standard methods.
CO4: Differentiate pollution sources and analyze the effectiveness of various air and water pollution control equipment and treatment processes
CO5: Assess environmental protection strategies, pollution control legislation, institutional roles and environmental management systems for sustainable development.

CO-PO MAPPING

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	-	-	-	-	3	-	-	-	-	3	-	1	3
2	3	2	-	-	-	3	-	-	-	-	2	-	-	3
3	-	-	-	3	3	-	-	-	-	-	-	-	3	-
4	-	3	3	-	-	3	-	-	-	-	-	-	-	-
5	-	-	-	-	-	3	3	-	-	3	-	-	-	-
Avg.	3	2.5	3	3	3	3	3	-	-	3	2.5	-	2	3

UNIT 1 **MAN AND ENVIRONMENT** **09**

Overview (socio-economic structure & occupational exposures) – Scope of Environmental Engineering – pollution problems due to urbanization & industrialization

UNIT 2 **AIR AND WATER POLLUTION** **09**

Causes of air pollution – types & sources of air pollutants- Climatic & Meteorological effect on air pollution concentration- formation of smog and fumigation Biological Pollution (point & non-point sources) – Chemical Pollutants: Toxic Organic & Inorganic Chemicals – Oxygen demanding substances – Physical Pollutants: Thermal Waste – Radioactive waste – Physiological Pollutants: Taste affecting substances – other forming substances

UNIT 3 **ANALYSIS OF AIR AND WATER POLLUTANTS** **09**

Collection of Gaseous Air Pollutants- Collection of Particulate Pollutants – Analysis of Air Pollutants like : Sulphur dioxide – Nitrogen oxide – Carbon monoxide – Oxidants &Ozone – Hydrocarbons – Particulate Matter Adverse effects on: Human Health & Environment, Aquatic life, Animal life, Plant life — Water Pollution Measurement Techniques – Water Pollution Control Equipments & Instruments – Indian Standards for Water Pollution Control

UNIT 4 **AIR POLLUTION CONTROL MEASURES & EQUIPMENT** **09**

Control of Particulate Emission – Control of Gaseous Emission – Flue Gas Treatment Methods : Stacks Gravitational and Inertial Separation, Settling Chambers, Dynamic Separators, Cyclones, Filtration, Liquid Scrubbing, Spray Chambers, Packed Towers, Orifice and Ventury Scrubbers, Electrostatic Precipitators, Gas/solid Adsoruption, Thermal Decomposition

UNIT 5 **ENVIRONMENTAL LEGISLATIONS, AUTHORITIES & SYSTEMS** **09**

Air & Water Pollution Control Acts & Rules (Salient Features only) – Functions of State / Central Pollution Control Boards – Environmental Management System: ISO 14 000 (Salient Features only

TEXT BOOKS:

1 Concept of Ecology Prentice-Hall of India, N. Delhi, Kormondy
2 Environmental Science Environmental Pollution
3 Water Supply & Waste Water, . D. Lal

U23AGP45 **PRINCIPLES OF ORGANIC FARMING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Understand the fundamental principles, history, and global context of organic farming and biodiversity conservation.
2 Acquire knowledge of various organic nutrient sources and sustainable crop management practices.
3 Learn ecological approaches for managing weeds, pests, and diseases without chemicals.
4 Appreciate and evaluate Indigenous Technical Knowledge (ITK) used in organic agriculture.
5 Understand certification systems, quality standards, and explore market/export potential of organic produce.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Outline the fundamentals, evolution, principles and global relevance of organic farming and biodiversity conservation.

CO2: Interpret the role of soil organic carbon, organic nutrient sources and crop management practices in sustaining soil health

CO3: Implement non-chemical approaches for weed, pest and disease management using biological and cultural techniques

CO4: Examine indigenous technical knowledge (ITK) practices and analyze their scientific relevance in organic agriculture systems.

CO5: Appraise organic certification systems, quality standards, labeling requirements and market opportunities for organic produce.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	-	-	-	-	3	1	-	-	-	1	3	-	1
2	3	2	-	-	-	3	-	-	-	-	1	2	3	1
3	2	2	3	-	2	3	2	2	1	1	2	3	3	3
4	2	3	2	3	-	3	2	1	-	2	2	2	2	2
5	1	2	3	2	2	3	3	3	3	3	3	3	3	3
Avg.	2.2	2.25	2.7	2.5	2	3	2	1.7	1.7	2	1.8	2.6	2.8	2

UNIT 1 **Components and Principles of Organic** **09**

Organic farming: Definition - Scope - principles and concepts - history of organic farming – global scenario - biodiversity: importance and measure to preserve biodiversity - pre requisites for Organic farming - Soil organic carbon: status and improvement strategies.

UNIT 2 **Organic sources of Nutrients** **09**

Organic sources of nutrients - manures and other inputs - on farm and off farm sources - organic waste recycling - methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers.

UNIT 3 **Non - Chemical weed and Pest disease management** **09**

Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological measures - Bio-intensive pest and disease management.

UNIT 4 **Indigenous Technical Knowledge (ITK)** **09**

Indigenous Technical Knowledge (ITK) in organic agriculture - scientific rationale - soil, nutrient, weed, water, management - prospects and problems in organic farming.

UNIT 5 **Certification of label** **09**

Organic certification - NPOP guidelines - Certification agencies in India - crop production standards - Quality considerations - labelling and accreditation process - marketing and export opportunities.

TEXT BOOKS:

1 Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobros publishers. SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.
2 Ranjan Kumar Biswas.2014. Organic farming in India. N.D.Publishers.New Delhi.

REFERENCE BOOKS:

1 Panda, S.C. 2012. Principles and Practices of Organic Farming. Agribios (India), Jodhpur.
2 Gehlot, D. 2010. Organic Farming- Components and Management. Agribios (India), Jodhpur.
3 Dushyant Gehlot . 2010. Organic farming: Components and management.Agrobios (India), Jodhpur.

U23AGP46 IOT IN AGRICULTURE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1 Introduce the fundamentals of the Internet of Things (IoT) and its components.
2 Impart knowledge on IoT architecture, sensors, actuators, and communication protocols.
3 Explore applications of IoT in precision farming, irrigation, and greenhouse management.
4 Develop skills in designing and simulating IoT-based solutions for agriculture.
5 Understand data analytics and cloud integration in smart farming applications.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Recognize the fundamentals of IoT architecture, embedded systems, and their relevance within modern agricultural systems and value chains
CO2: Understand the operating principles of agricultural sensors, actuators, and microcontroller platforms used in smart farming environments
CO3: Implement basic IoT-based agricultural solutions by integrating sensors, actuators, communication protocols, and networking technologies
CO4: Analyze IoT-enabled agricultural applications such as precision farming, smart irrigation, greenhouse automation, and livestock monitoring using real-world case studies.
CO5: Assess cloud-integrated IoT agricultural systems by analyzing data workflows, visualization platforms, analytics techniques, and security challenges.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	2	1	-	2	1	-	-	1	-	2	3	2	1
2	3	3	2	2	2	2	1	1	-	1	2	3	3	2
3	2	2	3	3	3	3	-	2	2	2	3	2	2	3

4	2	1	2	1	3	1	1	-	2	-	2	2	1	2
5	2.5	2	2	2	2.5	1.7	1	1.5	1.7	1.5	2.2	2.5	2	2
Avg.	3	2	1	-	2	1	-	-	1	-	2	3	2	1

UNIT 1 **INTRODUCTION TO IoT AND AGRICULTURAL SYSTEMS** **09**

Introduction to IoT – Evolution, Elements, Characteristics – Basic IoT Architecture – Overview of Embedded Systems – Role of IoT in Agriculture – Smart Farming vs. Traditional Farming – Agricultural value chain and intervention points.

UNIT 2 **SENSORS AND ACTUATORS IN AGRICULTURE** **09**

Types of sensors: soil moisture, temperature, humidity, light intensity, pH, nutrient sensors – Working principles and applications – Actuators: valves, motors, and relays – Integration of sensors/actuators with microcontrollers (Arduino, ESP32, Raspberry Pi).

UNIT 3 **COMMUNICATION PROTOCOLS AND NETWORKING** **09**

Wireless communication technologies: Wi-Fi, LoRa, Zigbee, Bluetooth, NB-IoT – Networking layers in IoT – MQTT, HTTP, CoAP protocols – Edge and fog computing concepts – Data transmission, energy optimization and latency in field conditions.

UNIT 4 **IoT APPLICATIONS IN AGRICULTURE** **09**

Precision agriculture – Remote monitoring of soil and crop health – Smart irrigation systems – Pest and disease detection – Greenhouse automation – Livestock monitoring – Case studies of IoT use in Indian and global agri-projects.

UNIT 5 **DATA ANALYTICS AND CLOUD INTEGRATION** **09**

IoT data lifecycle – Introduction to cloud platforms: AWS IoT, Azure IoT, Google Cloud – Real-time data visualization using ThingSpeak, Blynk, Node-RED – Basics of analytics: descriptive, predictive – Security and privacy in IoT agriculture systems.

TEXT BOOKS:

1 Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 2017.
2 Vijay Madisetti and Arshdeep Bahga, *Internet of Things – A Hands-on Approach*, VPT, 2014.

REFERENCE BOOKS:

1 Shashank Tiwari, *Smart Farming: Technologies for IoT based Agriculture*, BPB Publications, 2021.
2 Alena, D. and R. S. Hakansson, *Learning Internet of Things*, Packt Publishing, 2015.
3 Jan Holler et al., *From Machine-to-Machine to the Internet of Things*, Academic Press, 2014.

U23AGP47 **LANDSCAPE ARCHITECTURE**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

1 To understand the paradigms in landscape architecture in the post-industrial revolution era and to understand the multifaceted dimensions of landscape architecture such as ecology, environment and sustainability.

2 To study the contemporary landscape and the manifestation in the western and Indian contexts.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: Identify the fundamental concepts of landscape architecture including site analysis, zoning, open space structure and contextual landscape planning.

CO2: Explain the relationship between human use of exterior spaces, landscape synthesis, and design principles in landscape project formulation.

CO3: Develop landscape design solutions incorporating site mobilization practices, hardscape detailing, irrigation layouts and outdoor lighting systems

CO4: Analyze landscape design components such as circulation, lighting effects, irrigation systems and water features for functionality, sustainability and safety

CO5: Assess landscape proposals by integrating ecological, cultural, visual and technical considerations to recommend appropriate landscape treatments.

CO-PO MAPPING

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	2	-	-	-	3	-	-	-	-	2	2	-	1
2	3	3	2	-	-	3	-	-	1	-	2	2	2	1
3	2	2	3	2	3	3	1	2	2	2	2	3	3	3
4	2	3	2	3	2	3	2	-	2	2	3	3	3	2
5	1	2	3	2	2	3	3	3	3	3	3	3	3	3
Avg.	2.2	2.4	2.5	2.3	2.3	3	2	2.5	2	2.3	2.4	2.6	2.7	2

UNIT 1 BASICS OF LANDSCAPE ARCHITECTURE 09

Site analysis, synthesis, suitability, landscape zoning and planning with landscape land uses for medium to large scale projects. Evolving an open space structure for the site and suggesting a suitable landscape treatment with respect to ecological, functional, cultural and visual contexts.

UNIT 2 LANDSCAPE FORMULATIONS 09

Process for landscape project formulation and landscape design development based on synthesis. Examining how humans occupy exterior space and combines this information with the principles of design to create garden scale models

UNIT 3 SITE MOBILIZATION 09

Site mobilization; Sequence of site activity, site protection measures, site implementation checklist. Design and detailing of hard landscapes: Roads, paving, barriers, edge conditions -functions, types, criteria for selection, design aspects, details.

UNIT 4 ILLUMINATION 09

Outdoor lighting: Definition of technical terms, types of electrical lighting, types of fixtures, auxiliary fixtures. Principles of design for outdoor illumination, design and type of effects with electrical lighting. Safety precautions and drawbacks of electrical lighting, electrical accessories and their installation. Solar energy and lighting.

UNIT 5 **IRRIGATION FEATURES** **09**

Water features and Irrigation systems: Design of water features such as swimming pools, cascades, fountains etc., and their technical requirements. Consideration for design and detail of water bodies and natural ponds. Design of irrigation system — landscape area types, Course Overviews and design, water needs and sources, application, methods of installation. Control systems, scheduling and maintenance.

TEXT BOOKS:

1 Simonds. J. O. 1961. Landscape Architecture: The Shaping of Man's Natural Environment.
2 F.W. Dodge Cooperation, London Harris.C.W. and Din, N.T. 1997. Time Saver Standards For Landscape Architecture. Mcgraw — Hill International Edition, Arch. Series
3 Starke .B. and Simonds, J. O. 2013. Landscape Architecture: A Manual of Site Planning and Design. 5th edition. McGraw-Hill Professional.

REFERENCE BOOKS:

1 Shaheer, M., Dua, G.W. and Pal, A.2012. Landscape Architecture in India: A Reader. Indian Journal of Landscape Architecture.
2 Reid, G. W. 1993. From Concept to Form: In Landscape Design. John Wiley & Sons

CURRICULUM AND SYLLABI

B.TECH AGRICULTURAL ENGINEERING