PAAVAI ENGINEERING COLLEGE, NAMAKKAL 637018
(AUTONOMOUS)
DEPARTMENT OF AGRICULTURAL ENGINEERING
REGULATIONS 2023
CURRICULUM
(For candidates admitted during the Academic Year 2023 Onwards)
(CHOICE BASED CREDIT SYSTEM)
SEMESTER I

S.No.	Category	Course code	Course Title	L	T	P	C
Theory							
1			Induction Programme				
2	HS	GE23101	தமிழர்மரபு / Heritage of Tamils	1	0	0	1
3	BS	MA23101	Matrices and Calculus	3	1	0	4
4	BS	CH23102	Chemistry for Engineers	3	0	0	3
5	ES	EE23101	Basic Electrical and Electronics Engineering	3	0	0	3
6	PC	AI23101	Principles and Practices of Crop Production	3	0	0	3
Theory with Practical							
7	HS	EN23101	Communication skills for Engineers -I	2	0	2	3
Practical							
8	BS	CH23104	Chemistry Laboratory	0	0	2	1
9	ES	GE23102	Electrical and Electronics Engineering Practices Laboratory	0	0	2	1
10	PC	AI23102	Crop Production Practices Laboratory	0	0	2	1
			TOTAL	**15**	**1**	**8**	**20**

SEMESTER II

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	GE23201	தமிழரும் தொழில்நுட்பமும்/Tamils and Technology	1	0	0	1
2	BS	MA23201	Complex Variables and Differential Equations	3	1	0	4
3	BS	PH23203	Physics for Agricultural Engineering	3	0	0	3
4	ES	ME23201	Engineering Graphics	2	0	2	3
5	ES	CS23201	Problem Solving and Python Programming	3	0	0	3
Theory with Practical							
6	HS	EN23201	Communication Skills for Engineers II	2	0	2	3
Practical							
7	BS	PH23206	Physics Laboratory for Agricultural Engineering	0	0	2	1
8	ES	GE23203	Civil and Mechanical Engineering Practices Laboratory	0	0	2	1
9	ES	CS23202	Problem Solving and Python Programming Laboratory	0	0	4	2
			TOTAL	**14**	**1**	**12**	**21**

PAAVAI ENGINEERING COLLEGE (Autonomous) Approved BOARD OF STUDIES Agricultural Engineering Namakkal - 637

SEMESTER III

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	BS	MA23301	Transform Techniques and Partial Differential Equations	3	1	0	4
2	PC	AI23301	Principles and Practices of Horticultural Crop Production	3	0	0	3
3	PC	AI23302	Surveying and Levelling	3	0	0	3
4	PC	AI23303	Principles of Soil Science and Engineering	3	0	0	3
5	MC	MC23301	Environmental Science and Engineering	2	0	0	0
Theory with Practical							
6	ES	AI23304	Fluid Mechanics and Hydraulics	3	0	2	4
Practical							
7	PC	AI23305	Surveying and Leveling Laboratory	0	0	4	2
8	PC	AI23306	Soil Science laboratory	0	0	4	2
9	EE	GE23301	Professional Development I	0	0	2	1
			TOTAL	**17**	**1**	**12**	**22**

SEMESTER IV

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	BS	MA23403	Probability and Statistics	3	1	0	4
2	PC	AI23401	Strength of Materials for Agricultural Engineering	3	0	0	3
3	PC	AI23402	Hydrology and Water Resources Engineering	3	0	0	3
4	ES	AI23403	Mechanics of Machines	3	0	0	3
5	MC	MC23402	Human values and Gender Equality	2	0	0	0
Theory with Practical							
6	PC	AI23404	Farm Tractors	3	0	2	4
Practical							
7	PC	AI23405	CAD Laboratory for Agricultural Engineering	0	0	4	2
8	PC	AI23406	Strength of Materials Laboratory	0	0	4	2
9	EE	GE23402	Professional Development II	0	0	2	1
			TOTAL	**17**	**1**	**12**	**22**

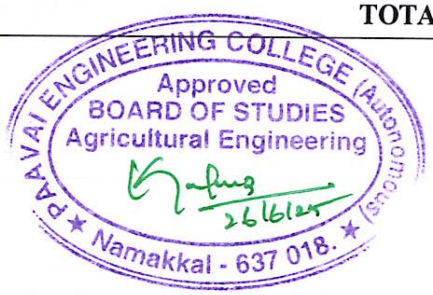
PAAVAI ENGINEERING COLLEGE (Autonomous) Approved BOARD OF STUDIES Agricultural Engineering 26/6/25 Namakkal

SEMESTER V

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	AI23501	Agricultural Business Management and Entrepreneurship	3	0	0	3
2	PC	AI23502	Farm Machinery and Equipment	3	0	0	3
3	PC	AI23503	Unit Operations in Agricultural Processing	3	1	0	4
4	PC	AI23504	Soil and Water Conservation Engineering	3	0	0	3
5	PC	AI23505	Thermal Engineering	3	0	0	3
6	PE	AI2315*	Professional Elective – I	3	0	0	3
Practical							
7	PC	AI23506	Food and Dairy Engineering Laboratory	0	0	4	2
8	PC	AI23507	Farm Machinery and Equipment Laboratory	0	0	2	1
9	EE	AI23508	Industrial Training I	0	0	2	1
10	EE	GE23501	Professional Development III	0	0	2	1
			TOTAL	**18**	**1**	**10**	**24**

SEMESTER VI

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	******	Total Quality Management	3	0	0	3
2	PC	AI23601	Design of Farm Machinery and Equipment	3	0	0	3
3	PC	AI23602	Irrigation and Drainage Engineering	3	0	0	3
4	PC	AI23603	Artificial Intelligence in Agriculture	3	0	0	3
5	PE	AI2325*	Professional Elective II	3	0	0	3
6	OE	AI2390*	Open Elective-I	3	0	0	3
Practical							
7	PC	AI23604	Irrigation Field Laboratory	0	0	4	2
8	PC	AI23605	Post-Harvest Technology Laboratory	0	0	4	2
9	EE	******	Design Thinking I	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**



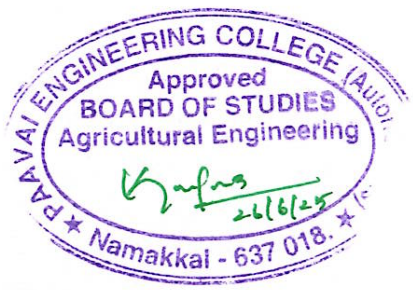
SEMESTER VII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	AI23701	Bio-Thermo Chemical Conversion of Bio Mass	3	0	0	3
2	PC	AI23702	Remote Sensing and GIS Application	3	0	0	3
3	PC	AI23703	Storage and Packaging Engineering	3	0	0	3
4	PE	AI2335*	Professional Elective III	3	0	0	3
5	PE	AI2345*	Professional Elective IV	3	0	0	3
6	OE	AI2390*	Open Elective-II	3	0	0	3
Practical							
7	PC	AI23704	GIS Laboratory for Agricultural Engineering	0	0	4	2
8	EE	AI23705	Mini Project	0	0	6	3
			TOTAL	**18**	**0**	**10**	**23**

SEMESTER VIII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	AI2355*	Professional Elective -V	3	0	0	3
2	PE	AI2365*	Professional Elective-VI	3	0	0	3
Practical							
3	EE	AI23801	Project Work	0	0	12	6
			TOTAL	**6**	**0**	**12**	**12**

TOTAL CREDITS: 167



PROFESSIONAL ELECTIVE COURSES – VERTICALS

VERTICALS I- AGRICULTURE AND FOOD PROCESSING

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	AI23151	Food Packaging Technology	3	0	0	3
2	PE	AI23152	Horticulture Crop Process Engineering	3	0	0	3
3	PE	AI23153	Refrigeration and Cold storage	3	0	0	3
4	PE	AI23154	Food and Diary Process Engineering	3	0	0	3
5	PE	AI23155	Food Process Equipment and Design	3	0	0	3
6	PE	AI23156	Food Plant Design and Management	3	0	0	3
7	PE	AI23157	Emerging Technologies in Food Processing	3	0	0	3

VERTICALS II – IRRIGATION AND WATER MANAGEMENT

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	AI23251	Command Area Water Management	3	0	0	3
2	PE	AI23252	Micro Irrigation System	3	0	0	3
3	PE	AI23253	Irrigation Economics	3	0	0	3
4	PE	AI23254	Automation in Irrigation	3	0	0	3
5	PE	AI23255	Integrated Water Resources and Participatory Management	3	0	0	3
6	PE	AI23256	Irrigation Water Quality	3	0	0	3
7	PE	AI23257	Watershed Planning and Management	3	0	0	3

VERTICAL III – FARM MACHINERY AND EQUIPMENT

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	AI23351	Precision Farming Equipment	3	0	0	3
2	PE	AI23352	Industrial Safety Management	3	0	0	3
3	PE	AI23353	Land Grading and Earth Moving machinery	3	0	0	3
4	PE	AI23354	Special Farm Machinery and Equipment	3	0	0	3
5	PE	AI23355	Plant Protection Equipment	3	0	0	3
6	PE	AI23356	Testing and Evaluation of Farm Machinery and Equipment	3	0	0	3
7	PE	AI23357	Mechanics of Tillage and Traction	3	0	0	3

VERTICAL IV- GENERAL AGRICULTURE

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	AI23451	Sustainable Agriculture and Food Security	3	0	0	3
2	PE	AI23452	Protected Cultivation and Precision Farming	3	0	0	3
3	PE	AI23453	Agricultural Economics and Extension	3	0	0	3
4	PE	AI23454	Agricultural Structure and Environmental Control	3	0	0	3
5	PE	AI23455	Seed Production Technology	3	0	0	3
6	PE	AI23456	Climate Change and Adaptation	3	0	0	3
7	PE	AI23457	System Analysis in Agricultural Engineering	3	0	0	3

VERTICAL V – ENERGY MANAGEMENT

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	AI23551	Ergonomics and Safety in Agricultural Engineering	3	0	0	3
2	PE	AI23552	Energy Conservation in Food Processing Industry	3	0	0	3
3	PE	AI23553	Principles of Heat and Mass Transfer	3	0	0	3
4	PE	AI23554	Bio Energy Resource Technology	3	0	0	3
5	PE	AI23555	Energy Auditing and its Management	3	0	0	3
6	PE	AI23556	Co-Generation and Waste Heat Recovery Systems	3	0	0	3
7	PE	AI23557	Air Pollution and Control Engineering	3	0	0	3

VERTICAL VI – AGRICULTURAL MANAGEMENT

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	AI23651	Disaster Management	3	0	0	3
2	PE	AI23652	Landscape Design and Site Planning	3	0	0	3
3	PE	AI23653	Industrial Agro forestry	3	0	0	3
4	PE	AI23654	Flood and Control Measures	3	0	0	3
5	PE	AI23655	Urban Agriculture	3	0	0	3
6	PE	AI23656	Drought Risk Assessment and Management	3	0	0	3
7	PE	AI23657	Digital Agricultural Marketing	3	0	0	3

PAAVAI ENGINEERING COLLEGE (Autonomous)
Approved
BOARD OF STUDIES
Agricultural Engineering
26/6/25
Namakkal - 637 018.

OPEN ELECTIVE-I

S. No	Category	Course Code	Course Title	L	T	P	C
1	OE	AI23901	Agricultural Waste Management	3	0	0	3
2	OE	AI23902	Entrepreneurial Agriculture	3	0	0	3

OPEN ELECTIVE-II

S. No	Category	Course Code	Course Title	L	T	P	C
1	OE	AI23903	Integrated Farming System	3	0	0	3
2	OE	AI23904	Farm mechanization	3	0	0	3

MINOR- AGRICULTURAL SYSTEMS							
S. No	Category	Course Code	Course Title	L	T	P	C
1	MDC	AI23851	Fundamentals of Horticulture	3	0	0	3
2	MDC	AI23852	Farming System and Sustainable Agriculture	3	0	0	3
3	MDC	AI23853	Landscaping and Ornamental Gardening	3	0	0	3
4	MDC	AI23854	Environmental Soil Physics	3	0	0	3
5	MDC	AI23855	Poultry Farm Management	3	0	0	3
6	MDC	AI23856	Fundamentals of Aquaculture	3	0	0	3

PAAVAI ENGINEERING COLLEGE (Autonomous)
Approved
BOARD OF STUDIES
Agricultural Engineering
26/6/25
Namakkal - 637 018.

CURRICULUM STRUCTURE

S.No.	Category	Credit Range		Total Credits	Number of Courses
		Min	Max		
1	Humanities and Social Sciences (HS)	10	14	11	5
2	Basic Sciences (BS)	25	28	24	8
3	Engineering Sciences (ES)	20	24	20	9
4	Programme Core Courses (PC)	55	70	73	26
5	Programme Elective Courses (PE)	15	18	18	6
6	Open Elective Courses (OE)	6	12	6	4
7	Employability Enhancement Courses (EE)	11	13	15	8
8	Mandatory Course (MC)	-	-	-	2
	Total				66

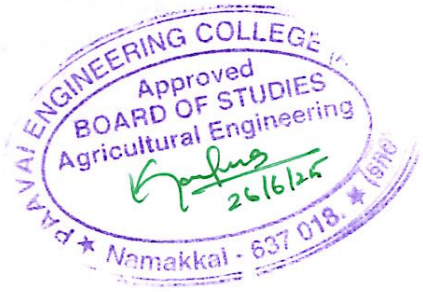
SUMMARY

S.No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	CREDITS IN%
		I	II	III	IV	V	VI	VII	VIII		
1	HS	4	4	-		3				11	6
2	BS	8	8	4	4					24	14
3	EE			1	1	2	1	3	6	14	8
4	ES	4	9	4	3					20	12
5	PC	4		13	14	16	16	11		74	44
6	PE					3	3	6	6	18	11
7	OE				0	0	3	3		06	4
8	MC	0	0	0	0					0	
TOTAL		20	21	22	22	24	23	23	12	167	100

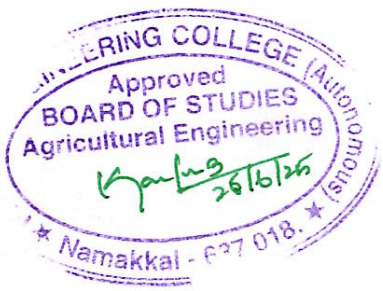
ONE CREDIT COURSES							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	OCC	AI23951	Production Technology of Agricultural Machinery	1	0	0	1
2	OCC	AI23952	Mushroom Production Technology	1	0	0	1
3	OCC	AI23953	Training on the Manufacture of Agricultural Implements	1	0	0	1
4	OCC	AI23954	Agro Processing Centre	1	0	0	1
5	OCC	AI23955	Coconut Processing and Value Addition	1	0	0	1
6	OCC	AI23956	Millet Processing and Cookies	1	0	0	1
7	OCC	AI23957	Aquaculture Technology	1	0	0	1
8	OCC	AI23958	Traditional Indian Foods	1	0	0	1
9	OCC	AI23959	Processing of Fruits and Vegetables	1	0	0	1
10	OCC	AI23960	Sugar Technology	1	0	0	1

VALUE ADDED COURSES

S.No	Category	Course Code	Course Title
1	VC	23AIVC101	Kitchen and Roof Gardening
2	VC	23AIVC201	Florist
3	VC	23AIVC301	Bee Keeping
4	VC	23AIVC401	Small Millet Cultivation and Value Addition
5	VC	23AIVC501	Medicinal Plants
6	VC	23AIVC601	Nursery Techniques and Propagation of Horticultural Crops



VERTICALS I	VERTICALS II	VERTICAL III	VERTICAL IV	VERTICAL V	VERTICAL VI
AGRICULTURE AND FOOD PROCESSING	**IRRIGATION AND WATER MANAGEMENT**	**FARM MACHINERY AND EQUIPMENT**	**GENERAL AGRICULTURE**	**ENERGY MANAGEMENT**	**AGRICULTURAL MANAGEMENT**
Food Packaging Technology	Command Area Water Management	Precision Farming Equipment	Sustainable Agriculture and Food Security	Ergonomics and Safety in agricultural Engineering	Disaster Management
Horticulture Crop Process Engineering	Micro Irrigation System	Industrial Safety Management	Protected Cultivation And Precision Farming	Energy Conservation in Food Processing Industry	Landscape Design and Site Planning
Refrigeration and Cold storage	Irrigation Economics	Land Grading and Earth Moving machinery	Agricultural Economics and Extension	Principles of Heat and Mass Transfer	Industrial Agro forestry
Food and Diary Process Engineering	Automation in Irrigation	Special Farm Machinery and Equipment	Agricultural Structure and Environmental Control	Bio Energy Resource Technology	Flood and Control Measures
Food Process Equipment and Design	Integrated Water Resources and Participatory Management	Plant Protection Equipment	Seed Production Technology	Energy Auditing and its Management	Urban Agriculture
Food Plant Design and Management	Irrigation Water Quality	Testing and Evaluation of Farm Machinery and Equipment	Climate Change and Adaptation	Co-Generation And Waste Heat Recovery Systems	Drought Risk Assessment and Management
Emerging Technologies in Food Processing	Watershed Planning and Management	Mechanics of Tillage and Traction	System Analysis in Agricultural Engineering	Air Pollution and Control Engineering	Digital Agricultural Marketing



AI23501	AGRICULTURAL BUSINESS MANAGEMENT AND ENTREPRENEURSHIP	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	know the importance of agri-business management, its characteristics and principles
2	impart knowledge on the functional areas of Agri-business like employee management, quality control and SWOT Analysis.
3	be familiar with Production, Operations, management and marketing techniques.
4	learn the various aspects of financial management in agricultural business, branding and promotion
5	ability to use effectively business management techniques in an international environment.

UNIT I	CONCEPTS OF AGRICULTURAL BUSINESS	9

Agri-business - scope, characteristics, types; Management - importance, definition, management and administration, management thoughts, Small business - characteristics and stages of growth - Management functions - planning, organizing, leading.

UNIT II	AGRI – BUSINESS ORGANIZATION	9

Principles, forms of agri-business organizations, staffing, directing, supervision and motivation; Controlling – types, performance evaluation and control techniques. Management approaches –Profit Centered Approach, Management by objectives and Quality Circles. Strength, Weakness, Opportunities and Threat (SWOT) Analysis.

UNIT III	AGRICULTURAL MARKETING	9

Functional areas of Agri-business - Production and Operations management – functions, planning and managing quality; Agro-inputs and products inventory management – raw material procurement, inventory types, and costs. Supply chain management-Marketing management - Marketing environment, marketing mix – Agricultural input marketing firms.

UNIT IV	AGRICULTURAL BUSINESS FINANCE& MARKET PROMOTION	9

Forms of agri-business organizations - Role of lead bank in agribusiness finance - Financial management. Acquiring capital – Budget analysis ; Agricultural products - marketing promotion activities - product pricing methods; District Industries Centre ; Return on Investment- Market potential assessment.

UNIT V	ENTREPRENEURSHIP	9

Entrepreneur –Definition, functions, qualities and roles in economic development- Types of Entrepreneurship – Innovation in Agri business-role of innovation in sustainable agriculture and value addition; Business incubation and acceleration –functions, structure and role in agribusiness startups and Financing entrepreneurs-risk management in Entrpreunership;Role of Agritech, Digital platforms and Agri business incubators.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the importance of Agri-business management, its characteristics and principles	Understanding (K2)
CO2	understand the methods of managing employees, quality control and SWOT analysis	Understanding (K2)
CO3	infer the functions of Production and Operations management and marketing techniques.	Understanding (K2)
CO4	build knowledge on various aspects of financial management in agribusiness, branding and promotion..	Applying(K3)
CO5	simplify the systematic process to elect and ability to discern distinct entrepreneurial traits.	Analyzing (K4)

TEXT BOOKS

1. Agri Business Management by John C.Foltz, Elizabeth A Yeager, Freddie L. Barnard 4th edition. 2012
2. S. Diwase, "Indian Agriculture &Agri-Business Management", Scientific Publishers, 2nd edition, 2014.

REFERENCES

1. Chandra Prasanna,"Projects: Preparation, Appraisal, Budgeting and Implementation", TataMcGraw Hill Publications, New Delhi, 2001.
2. Adams, C.R. K.M. Bandford and M.P. Early. 1996 "Principles of Horticulture" CBS publishers and distributors. Darya ganj, New Delhi.
3. Kotler,P.,"Marketing Management Analysis, Planning and Control", Prentice HallInc., NewYork,2001.

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	3	1	1	-	-	1	2	-	3	-	2	-
CO2	1	2	2	-	1	-	-	-	-	-	-	-	2	-
CO3	1	2	2	3	2	2	3	1	3	3	3	2	2	-
CO4	1	2	2	1	-	1	1	2	3	2	2	1	2	1
CO5	1	2	2	1	2	1	1	2	2	2	2	1	2	2

AI23502	FARM MACHINERY AND EQUIPMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart knowledge on different farm mechanized machinery like tractor, power tiller, their utilities and maintenance.
2	gain knowledge on machine dynamics and hitching.
3	study the working principles of tillage equipments.
4	introduce knowledge on equipments likely to be used in various activities of crop plantation.
5	get an idea about the harvesting and threshing equipments.

UNIT I	FARM MECHANIZATION, TRACTOR AND POWER TILLER	9

Farm mechanization - objectives - scope and importance; Tractors - Selection and Classification - identification of major systems - components and their uses; Preliminary check-up's and safety aspects before starting a tractor and power tiller- procedure for starting, running and stopping the tractor and power tiller - precautions in driving tractor and power tiller on-road and field.

UNIT II	MACHINE DYNAMICS AND HITCHING	9

Dynamic soil properties affecting soil tool interaction; Force analysis of tillage tools and their measurement; Hitching- horizontal – vertical and three point - adjustments; Yokes and harness for draught animals and mechanics of hitching.

UNIT III	TILLAGE EQUIPMENTS	9

Primary Tillage Equipment - Mould board plough - animal and power operated, types and construction, working principles - accessories - forces acting on mould board bottom; Disc ploughs - types and construction, soil reaction, side thrust and draft; Secondary Tillage Equipment - cultivator - disc harrow - types and construction - selection.

UNIT IV	EQUIPMENT FOR FARMING OPERATIONS	9

Sowing / seeding, planting and fertilizer application equipment - construction and working principles – Seed and fertilizer metering devices - furrow openers and covering devices - Calibration - field adjustment and operations - Paddy planters; Intercultural Equipment - Cultivators - rotary hoes - sweeps and shovels - types and uses; Weeders - classification of weeders according to power sources; Plant protection equipments – types construction and working principle - Selection of equipment for spraying and dusting - Safety aspects.

UNIT V	EQUIPMENT FOR HARVESTING AND SPECIAL OPERATIONS	9

Harvesting and Threshing - Classification - construction and working principles of reapers mowers - combined harvesters and power threshers; Specialized Crop Equipment for maize - cotton - sugarcane - root crops and horticultural crops; Ergonomics studies and safety of Farm Machinery and Equipment.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the operations of various farm equipments and machinery for farm mechanizations.	Understanding (K2)
CO2	gain sufficient knowledge on machine dynamics and hitching.	Applying (K3)
CO3	have knowledge on different types of tillage equipments.	Applying (K3)
CO4	get an idea about the mechanization for different crops.	Applying (K3)
CO5	enhance knowledge on harvesting and threshing equipments.	Applying (K3)

TEXT BOOKS

1. Jain, S.C. and C.R. Rai., "Farm tractor maintenance and repair", Standard publishers and distributors, New Delhi, 1999.
2. Jagadishwar Sahay , "Elements of Agricultural Engineering", Standard Publishers Distributors, New Delhi, 2016.

REFERENCES

1. John A Havers and Frank W Stubbs, "Hand book of Heavy Construction", McGraw - Hill book Company, New York, 1971.
2. Ojha,T.P. and A.M.Michael, "Principles of Agricultural Engineering Volume-I", Jain Brothers, New Delhi,2014.
3. Barger, E.L., J.B. Liljedahl and E.C. McKibben, "Tractors and their Power Units" Wiley Eastern Pvt. Ltd., New Delhi, 1997.
4. Harris Pearson Smith "Farm Machinery and Equipment", Bio-Green, New Delhi, 2013.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	-	-	-	1	-	1	-	-	-	-	-	2
CO2	3	1	1	1	-	-	1	-	-	2	1	-	3	2
CO3	2	-	2	1	2	-	-	-	1	-	-	-	3	2
CO4	3	-	1	1	-	1	-	1	-	1	1	2	-	3
CO5	3	2	-	-	2	-	1	-	1	-	-	-	3	-

AI23503	UNIT OPERATIONS IN AGRICULTURAL PROCESSING	3	1	0	4

COURSE OBJECTIVES

To enable the students to

1	understand the scope, importance, and basic concepts of food process engineering.
2	acquire the principles and operations involved in evaporation, filtration, and sedimentation.
3	recognize methods and equipment used for size reduction in food processing.
4	analyze the working of contact equilibrium separation processes
5	classify the basic concepts and equipment used in crystallization and distillation.

UNIT I	EVAPORATION AND CONCENTRATION	12

Unit operations in food processing - conservation of mass and energy, overall view of an engineering process; 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; Evaporator types - once through evaporator, circulation evaporator.

UNIT II	FILTRATION AND SEDIMENTATION	12

Filtration - definition, filter media, types and requirements; Constant rate and constant pressure filtration; Filter cake resistance; Filtration equipment - rotary vacuum filter, filter press. Sedimentation - gravitational sedimentation of particles in fluid, Stoke's law, sedimentation of particles in gas, cyclones; Settling and gravitational sedimentation; Centrifugal separation methods - liquid-liquid separation, centrifuge equipment.

UNIT III	SIZE REDUCTION	12

Size reduction - grinding and cutting, principles of comminuting; Characteristics of comminuted products, particle size distribution; Energy and power requirements; Crushing efficiency; Size reduction laws - Rittinger's law, Kick's law (descriptive study). Size reduction equipment - jaw crusher, hammer mill

UNIT IV	CONTACT EQUILIBRIUM SEPARATION	12

Contact equilibrium separation - concentrations, gas-liquid and solid-liquid equilibrium, equilibrium concentration relationships; Operating conditions of separation (descriptive study); Gas absorption equipment - stage equilibrium system, packed tower. Tower packing - Raschig rings, Berl saddles, construction, flow through packed towers; Extraction equipment - Dorragitator, extraction tower. Continuous leaching, decantation systems, extraction towers, washing equipment.

UNIT V	CRYSTALLIZATION AND DISTILLATION	12

Crystallization - equilibrium, rate of crystal growth, stage equilibrium crystallization; Crystallizers - tank crystallizer, vacuum crystallizer. Distillation - binary mixtures, flash and differential distillation, steam distillation, theory; Continuous distillation with rectification, vacuum distillation; Batch distillation - operation, advantages, limitations; Distillation equipment - batch distillation unit, rectification column.

	TOTAL PERIODS	60

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	know the importance of unit operations in food processing	Understanding (K2)
CO2	apply principles and equipment for evaporation, filtration, and sedimentation.	Applying (K3)
CO3	demonstrate knowledge of size reduction processes and equipment in food processing	Applying (K3)
CO4	analyze the mechanisms and equipment used in contact equilibrium separation	Analyzing (K4)
CO5	examine the application of crystallization and distillation in food processing	Analyzing (K4)

TEXTBOOKS

1. Ibarz, A. and Barbosa-Cánovas, G.V "Unit Operations in Food Engineering". CRC Press, Boca Raton, USA, 2003.ISBN: 9781566769296.
2. Jafari, S. M. (Ed.) – "Engineering Principles of Unit Operations in Food Processing", Woodhead 2021

REFERENCES

1. Singh, R.P. and Heldman, D.R. "Introduction to Food Engineering". Academic Press, Elsevier, 2009. ISBN: 9780123709004..
2. Earle, R.L. and Earle, M.D. "Unit Operations in Food Processing (2nd Edition)". Pergamon Press, Oxford, U.K., 1983. ISBN: 9780080249106
3. Smith, P.G. "Introduction to Food Process Engineering". Springer, New York, 2005. ISBN: 9780387232459.
4. Sahay, K.M. and Singh, K.K. "Unit Operations of Agricultural Processin(3rd Edition)". Vikas Publishing House Pvt. Ltd., New Delhi, 2004. ISBN: 9788125916823.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes(PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	2	1	1	1	1	2	1	2	2	2
CO2	3	2	2	3	3	1	1	-	1	2	-	2	3	2
CO3	3	2	3	3	2	2	-	-	-	1	1	1	2	3
CO4	2	3	2	3	3	1	2	1	1	-	2	1	3	3
CO5	3	3	3	2	3	2	2	1	1	1	-	2	3	2

AI23504	SOIL AND WATER CONSERVATION ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	identify major causes and types of soil erosion and classify erosion based on agents and severity.
2	interpret soil loss estimation models and compute erosion rates using USLE and related equations.
3	describe and select appropriate agronomic and mechanical measures for effective erosion control.
4	analyze sedimentation processes and evaluate suitable techniques for sediment load reduction.
5	develop integrated water conservation plans and design site-specific harvesting structures for sustainable resource use.

UNIT I	SOIL EROSION AND ITS TYPES	9

Introduction and concept of soil erosion; Causes, Types and Agents of Erosion - Factors affecting erosion, erosion problems; Water erosion - Types and mechanics of water erosion, raindrop erosion, sheet erosion, rill erosion; Gully erosion & its classification, stream bank erosion; Wind erosion - Types and mechanics.

UNIT II	ESTIMATION OF SOIL EROSION	9

Universal Soil Loss Equation - Estimation by standard plots, evaluation, applications and limitations; Revised Universal Soil Loss Equation; Modified Universal Soil Loss Equation; Permissible erosion; Land use capability classification; Classification of eroded soils.

UNIT III	EROSION CONTROL MEASURES	9

Soil management practices - Agronomic practices, contour cultivation, strip cropping, tillage practices; Mechanical measures for plains - Contour and graded bunding, types and design specifications; Mechanical measures for hill slopes - Terracing , classification and design specification of bench terrace ; Contour stone wall; Types of temporary and permanent gully control structures; Multislot diversors- design and application; Wind erosion control measures - wind breaks & shelter belts.

UNIT IV	SEDIMENTATION	9

Sedimentation - Sources, types of sediment load, estimation of bed load; Mechanics of sediment - Transport sediment graph, factors affecting sediment distribution pattern; Silt detention tanks; Reservoir sedimentation and estimation.

UNIT V	WATER CONSERVATION MEASURES	9

In-situ soil moisture conservation; Roof top water conservation; Water harvesting -importance, types; Runoff Harvesting techniques- Short term and Long term; Water storage structures - Percolation ponds, Farm ponds, components, design, construction and Protection.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	classify the various types of soil erosion and suggest the suitable preventive measures.	Understanding (K2)
CO2	estimate the quantity of soil eroded using different relationships	Analyzing (K4)
CO3	select the appropriate erosion control measures based upon the characteristics of land	Applying (K3)
CO4	estimate the sediment load and suggest suitable control techniques.	Analyzing (K4)
CO5	implement advanced water conservation techniques.	Applying (K3)

TEXTBOOKS

1. Suresh, R., "Soil and Water Conservation Engineering", Standard Publication, New Delhi, 2020.
2. Gupta S.K., "Fundamentals of Soil and Water Conservation Engineering", Daya Publishing House, 2020.

REFERENCES

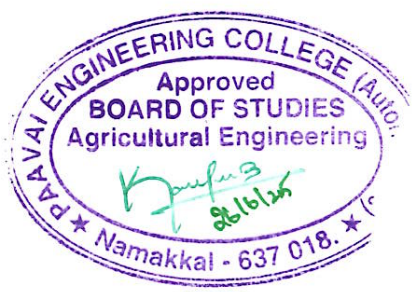
1. Dr Praveen Kumar Tiwari., "Soil and Water Conservation Handbook", Raj Publication, 2017.
2. A hand book on "Soil and Water Conservation", Indian Council of Forestry Research and Education, Dehradun, 2020.
3. NPTEL course: https://archive.nptel.ac.in/courses/126/105/126105012/.
4. Schwab, G. O., Frevert, R. K., Edminster, T. W., & Barnes, K. K., "Soil and Water Conservation Engineering" (4th ed.). New York: John Wiley & Sons., 1993.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S)

(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

Cos	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	2	1	-	2	2	-	-	-	-	1	3	2
CO2	2	2	1	2	-	2	1	-	-	-	-	2	3	2
CO3	1	-	1	1	2	1	2	-	-	-	2	1	3	2
CO4	2	1	2	1	1	1	1	-	-	-	-	2	3	2
CO5	2	2	3	1	1	1	3	-	-	-	2	1	3	2



AI23505	THERMAL ENGINEERING	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the fundamental concepts and first law of thermodynamics.
2	know the second law and its application.
3	apply combustion analysis and engine performance.
4	impart knowledge in the properties of mixture of gases.
5	analyze the work done and volumetric efficiency.

UNIT I	BASIC CONCEPTS AND FIRST LAW	9

Definition of Thermodynamics – Thermodynamic systems, Comparison of microscopic and macroscopic approach, pure substance, thermodynamic equilibrium, properties of systems, thermodynamic process and cycles, temperature; Zeroth law of thermodynamics; First law of Thermodynamics-Internal energy, law of conservation of energy- steady flow processes; Application of first law to steady flow process.

UNIT II	SECOND LAW OF THERMODYNAMICS	9

Performance of heat engines and reversed heat engine - Statements of second law of thermodynamics, carnot cycle, carnot theorem, corollary of carnot theorem, efficiency of the reversible heat engine, COP; Properties of Pure substances - Formation of steam, thermodynamic properties of steam.

UNIT III	INTERNAL COMBUSTION ENGINES	9

Combustion - Stoichiometry air fuel ratio, enthalpy of formation and enthalpy of combustion, adiabatic flame temperature; Otto and Diesel cycles; Internal combustion engines-combustion phenomenon in S.I & C.I. engines, diesel knock, octane and cetane number, supercharging, testing and performance of IC engines.

UNIT IV	IDEAL AND REAL GASES AND GAS MIXTURES	9

Ideal gas-The equation of state for a perfect gas, p-v-T surface of an ideal gas; Real gases-Vander waals equations, reduced properties, compressibility chart; Properties of mixture of gases-Dalton law and Gibbs law, volumetric analysis of a gas, apparent molecular weight and gas constant, specific heats of gas mixtures.

UNIT V	AIR COMPRESSORS	9

General aspects; Classification of air compressor; Reciprocating compressor-Single stage reciprocating compressor, equation for work, volumetric efficiency, multistage compressor, efficiency of compressor, isothermal efficiency, clearance in compressor, effect of clearance volume.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	apply the Zeroth Law of Thermodynamics to measure temperature	Applying (K3)

CO2	calculate entropy change for various thermodynamic processes.	Analyzing (K4)
CO3	perform testing procedures on internal combustion engines	Applying (K3)
CO4	analysis of gas mixtures and calculate apparent molecular weight	Analyzing (K4)
CO5	apply air compressors in agricultural machinery	Applying (K3)

TEXT BOOKS

1. R.K.Rajput, "Thermal Engineering", Laxmi publication (p) Ltd., New Delhi, 2010.
2. Nag.P.K., "Engineering Thermodynamics", Third Edition, Tata McGraw hill, 2005.

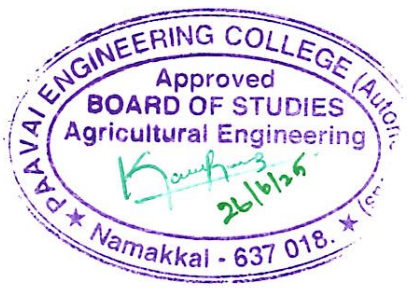
REFERENCES

1. Yunus. A.Cengel, M.Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, 2010.
2. Ganesan.V, "Internal Combustion Engines", Tata McGraw Hill, 2007
3. Domkundwar. S, C.P.Kothandaraman, "A course in Thermal Engineering", DhanpatRai& Co (P) Ltd, 2000.
4. Rudramoorthy. R, "Thermal Engineering" Tata McGraw Hill New Delhi,2003

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	3	1	-	-	-	-	-	-	1	2	1
CO2	2	3	2	3	1	-	-	-	-	-	-	1	2	1
CO3	2	3	2	3	1	-	-	-	-	-	-	1	3	1
CO4	2	3	2	3	1	-	-	-	-	-	-	1	2	1
CO5	2	3	2	3	1	-	-	-	-	-	-	1	2	1



AI23506	FOOD AND DAIRY ENGINEERING LABORATORY	0	0	4	2

COURSE OBJECTIVES	
To enable the students to	
1	develop practical skills in analysing the physical and thermal properties of food materials
2	impart knowledge of food processing techniques
3	build competencies in milk quality evaluation
4	apply physicochemical and microbiological tests for assessing milk safety and quality

LIST OF EXPERIMENTS	
1	Determination of size, roundness, sphericity and 1000 grain weight of food grains
2	Determination of angle of repose for grain sample.
3	Determination of bulk density, true density and porosity.
4	Experiment on drying characteristics of food material using tray dryer.
5	Experiment on studying the freezing characteristics of food material using Deep Freezer.
6	Determination of fineness modulus for ground material using ball mill.
7	Osmotic drying of foods with salt and sugar.
8	Experiment on paddy dehusker to determine the shelling efficiency.
9	Determination of MBRT and alcohol index test of milk.
10	Detection of adulterants in milk.
11	Determination of total milk protein content in milk.
12	Determination of acidity, specific gravity and clot-on-boil test of milk.
13	Determination of pasteurization efficiency of milk.
14	Estimation of Surface tension of milk.
15	Preparation of Paneer, Butter, Whey and Casein.
	TOTAL PERIODS **60**

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	analyze the physical properties of food grains	Understanding (K2)
CO2	apply food processing techniques to evaluate drying, separation, and dehusking operations	Applying (K3)
CO3	perform standard dairy testing procedures for quality and safety assessment	Analyzing (K4)
CO4	evaluate the efficiency of dairy processing equipment	Analyzing (K4)

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	2	2	-	-	-	-	-	-	3	2
CO2	3	1	2	1	1	-	-	-	-	-	-	-	3	2
CO3	-	3	2	2	1	1	-	-	-	-	-	2	2	2
CO4	-	-	3	1	2	2	-	-	-	-	-	2	3	2

PAAVAI ENGINEERING COLLEGE (Autonomous)
Approved
BOARD OF STUDIES
Agricultural Engineering
26/6/25
Namakkal - 637 018.

AI23507	FARM MACHINERY AND EQUIPMENT LABORATORY	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1	practice different operations in tractor, power tiller and studying various components of them.
2	study field operations of primary and secondary tillage implement and their adjustments.
3	have knowledge on field operation of sowing, plant protection equipments and their adjustments
4	learn operation of various types of sprayers, dusters, weeders and trailers in field level.

LIST OF EXPERIMENTS

(A) Tractor

1. Identification of major components of a tractor and preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.
2. Hitching of agricultural implement.

(B) Power Tiller

3. Identification of components of power tiller - its maintenance and study on preliminary check measures and safety aspects before starting a power tiller - procedure for starting - running and stopping the power tiller.
4. Repair - maintenance and off-season storage of farm equipment.

(C) Tillage Implement

5. Field operation and adjustments of primary tillage implement.
6. Field operation and adjustments of secondary tillage implement.

(D) Sowing, Weeding and Plant Protection Equipment

7. Field operation of sowing equipments and their adjustments.
8. Field operation of weeder and plant protection equipment.

(E) Harvesting Machineries

9. Demonstration of combined harvester.
10. Study on different types of trailer and hitching.

TOTAL PERIODS	**30**

COURSE OUTCOMES At the end of this course, students will be able to		**BT Mapped** (Highest Level)
CO1	practice operation of tractor and power tiller at field level.	Analyzing (K4)
CO2	gain in depth knowledge on field operation of tillage implements.	Applying (K3)
CO3	get experience in usage of sprayers, dusters and weeders in field level.	Applying (K3)
CO4	depict the requirement of repair, maintenance and off-season storage of farm equipment.	Applying (K3)

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	3	-	-	-	-	2	-	1	-	3	3
CO2	3	-	3	3	-	-	3	-	-	1	1	-	-	3
CO3	3	-	-	-	2	-	-	3	2	2	-	-	3	3
CO4	3	-	3	-	-	-	1	-	-	3	3	-	3	3

PAAVAI ENGINEERING COLLEGE (Auto
Approved
BOARD OF STUDIES
Agricultural Engineering
26/6/25
Namakkal - 637 018.

AI23508	INDUSTRIAL TRAINING I	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1	undergo training in field work by attaching to any industry/organization
2	have a firsthand knowledge and practical problems in agriculture engineering
3	develop skills in worth ethics in communication , management and others
4	gain the knowledge through hands on observation job execution

The students individually undertake training in reputed engineering companies, government organizations, NGOs, or educational institutions that work in thearea of the Agricultural Science for thespecified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by the internal staff.

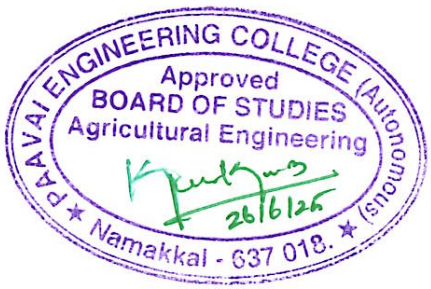
TOTAL PERIODS	**30**

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	gain working experience in carrying out engineering tasks related to agriculture	Applying(K3)
CO2	capability to acquire and apply fundamental principle of engineering	Applying (K3)
CO3	become master in one specialization	Applying (K3)
CO4	become updated with all the latest changes in technological world	Understanding(K2)

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

	PO'S												**PSO'S**	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	–	3	–	–	2	–	–	–	1	–	3	3
CO2	1	1	–	2	–	–	3	3	–	–	–	3	2	1
CO3	2	2	–	–	–	–	2	2	–	–	2	2	–	2
CO4	2	2	–	–	–	–	2	1	–	–	3	–	2	2



GE23501	PROFESSIONAL DEVELOPMENT III	0	0	2	1

COURSE OBJECTIVES

To enable students to

1.	enhance their Resume writing skills and improving corporate vocabularies to survive in the corporate world.
2.	evaluate their interview skills and improve their interview presentation.
3.	solve the quantitative aptitude problems and improve their mental ability.
4.	improve critical thinking and reasoning skills.

UNIT I	RESUME WRITING SKILLS	6

Updated Resume Building III – Self Introduction III – Dressing Etiquette – JAM V – Corporate Vocabulary.

UNIT II	INTERVIEW SKILLS	6

Interview skills – General guidelines - Work Ethics – Group Discussion III – JAM VI – Presentation Competence – Mock Interview.

UNIT III	QUANTITATIVE APTITUDE	9

Cube Root and Square Root - Time and Work - Ages - Permutation and Combination - Probability – Calendar.

UNIT IV	LOGICAL REASONING	9

Series Completion - Blood Relations - Coding and Decoding - Data Sufficiency - Statements and Assumptions.

TOTAL PERIODS: 30

COURSE OUTCOMES Upon completion of the course, the students will be able to		BT MAPPED (Highest Level)
CO1	excel in drafting Resumes and speaking.	Applying (K3)
CO2	demonstrate the participative skills in group discussions and Interviews.	Applying (K3)
CO3	solve problems based on quantitative aptitude.	Applying (K3)
CO4	enhance their logical and verbal reasoning.	Analyzing (K4)

TEXTBOOKS

1. Aggarwal, R. S. A Modern Approach to Verbal & Non-Verbal Reasoning. Revised ed., 2024–25, S. Chand & Company Ltd., 2024.
2. Aggarwal, R. S. Objective General English: Fully Revised Video Edition. S. Chand & Company Ltd., 2022.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hil1.2015.
2. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications.2016.
3. Johnson, D.W. Reaching out — Interpersonal Effectiveness and self- actualisation. Boston: Allyn and Bacon.2019.
4. Infosys Campus Connect Program — students' guide for soft skills.2015.

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3

AI23151	FOOD PACKAGING TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart knowledge about basics concepts in food packaging and extending shelf life of food products
2	understand the properties of food packaging materials for processed food products
3	explain the flexible packaging materials and their application in food products
4	knowledge about new innovation in developing advanced food packaging
5	enrich knowledge on laws and regulations of packaging materials and labelling of foods

UNIT I **BASICS OF FOOD PACKAGING** **9**

Introduction, Definitions, Functions of packaging - Containment, Protection, Convenience, Communication; Food package design and development; Current status in food packaging in India; Physical and Physio-Chemical processes affecting product quality, predicting the shelf life of foods.

UNIT II **PACKAGING MEDIA & MATERIALS** **9**

Metal packaging- Metals Tinplate, tinning process, components of tinplate, tin free can (TFC) types of can, metallic films, lacquers; Glass as package material, manufacture, advantages, disadvantages; Paper - different types - corrugated paper boards- definition - types -paper board products - Retort pouch packaging.

UNIT III **FLEXIBLE FILMS PACKAGING** **9**

Formation of Films and pouches, Plastics used and their Specific applications - Polyethylene (LDPE and HDPE) – Cellulose - Polypropylene (PP) – Polyesters - Polyvinylidene Chloride (PVDC - Diofan, Ixan and Saran) - Polyvinyl chloride - Copolymers their applications; Lamination - need of lamination - coefficient of friction - types, properties, advantages & disadvantages of each type.

UNIT IV **INNOVATION IN FOOD PACKAGING** **9**

Aseptic Packaging - Active packaging- Moisture control, CO2 and Oxygen scavenging; Modified atmosphere packaging – principles, applications, Permeability of gases in packs; Antimicrobial Packaging; Edible packaging films and coating; Packaging for non-thermal food processing; Smart packaging- Intelligent Packaging (Indicating Product Quality, Convenience, Theft, counterfeiting & Tampering).

UNIT V **REGULATORY ASPECTS OF PACKAGING** **9**

Food Packaging Laws and Regulations - Food Labelling, coding and marking including bar coding, Packaging Costs; Packaging Environmental consideration and restoration – sustainable development, biodiversity, global environment facility, environmental impact assessment, environmental protection act, national conservation strategies, ISO 14000. & waste management, Sources-Reduce, Reuse and Recycling (3R's), 7R's of Packaging, Biodegradable materials, Recycling techniques/methods.

TOTAL PERIODS **45**

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	infer basic concepts in food packaging	Understanding (K2)
CO2	choose appropriate metal, glass containers, paper and paperboards for food packaging	Applying (K3)
CO3	identify suitable plastic for packaging based on their properties	Applying (K3)

CO4	apply the new innovation in developing advanced packaging material	Applying (K3)
CO5	analyze the laws and regulations and labelling with respect to food packaging	Analyzing (K4)

TEXT BOOKS

1. Richard Coles and Mark J. Kirwan, "Food and Beverage Packaging Technology", 2nd Edition, Blackwell Publishing Asia Pvt Ltd, CRC press, USA, 2011.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Third Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2013.

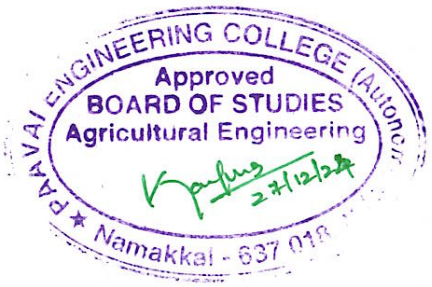
REFERENCES

1. Han Jung H, "Innovations in Food Packaging", 2nd Edition, Academic Press, USA, 2014.
2. K.L. Yam and D.S. Lee, Emerging Food Packaging Technologies, Principles and Practice, A volume in Woodhead Publishing series in Food Science, Technology and Nutrition, 2012.
3. Han, Jung H. "Innovations in Food Packaging". Elsevier, 2005.
4. NIIR Board, "Food Packaging Technology Handbook" (2nd Revised Edition), NIIR Project Consultancy Services, 2012.

CO PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	2	-	-	2	-	-	-	1	2	2
CO2	3	2	2	1	1	1	-	-	1	-	-	1	2	2
CO3	3	2	2	1	1	1	-	1	1	-	-	1	2	2
CO4	3	2	2	1	2	1	-	-	-	-	-	2	2	2
CO5	2	2	2	1	-	-	-	1	-	-	-	2	3	2



AI23152	HORTICULTURE CROP PROCESS ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand various processing technology on different horticultural crops and their importance.
2	impart knowledge on different packaging and grading techniques.
3	study about processing of coffee, tea and cocoa.
4	know about the by-products utilization and processing of oil seeds.
5	get an idea about processing of medicinal crops.

UNIT I	IMPORTANCE AND PROCESSING OF HORTICULTURAL CROPS	9

Unit operation in horticulture, scope and importance; primary and secondary processing, processing technologies, equipment, operations in grading, pre-treatment; principles and techniques in preservation of foods and vegetables, cold storage, freezing, addition of chemicals, dehydration and canning, packaging; value added products in horticultural crops. Importance of postharvest technology of fruits and vegetables.

UNIT II	PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES	9

Handling and packaging of fruits and vegetables, Cleaning and grading of spices, packaging and storage of spices; Grading specifications, AGMARK, ASTA, ESA specifications; Process involved in the manufacture of Oleoresions and essential oils; Quality analysis of spices and their derivatives.

UNIT III	PROCESSING OF COFFEE, TEA AND COCOA	9

Preservation by fermentation, Processing of coffee, tea and cocoa, Methods, Process and equipment, Value added Products, grading and types, packaging and storage.

UNIT IV	PROCESSING OF COCONUT, OILPALM, ARECANUT AND CASHEW	9

Processing of Plantation crops, production and importance; Processing of Coconut, oil palm, aerecanut, cashew, drying, cleaning and grading; Production of value added products- packaging and storage of produces, Common methods of storage.

UNIT V	PROCESSING OF MEDICINAL CROPS	9

Preservation Technology, Processing of medicinal crop- equipment used- principles and operations; Active Principles in various medicinal plants- application and uses, extraction methods.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	learn all the Horticultural crop processing techniques.	Understanding (K2)
CO2	get knowledge on cleaning, grading and packaging of processed horticultural by products.	Analysing (K4)
CO3	familiar with processing of tea, coffee and cocoa.	Applying (K3)
CO4	understand the processing of plantation crops.	Applying (K3)
CO5	gain knowledge on processing of medicinal crops.	Applying (K3)

TEXTBOOKS

1. Pandey, P.H., "Post-Harvest Engineering of Horticultural Crops through Objectives", Saroj Prakasam, Allahabad, 2002.
2. Pruthi, J.S., "Major Spices of India – Crop Management and Post- Harvest Technology", Indian Council of Agricultural Research, Krishi Anusadhan Bhavan, Pusa, New Delhi. PP. 514, 1998.

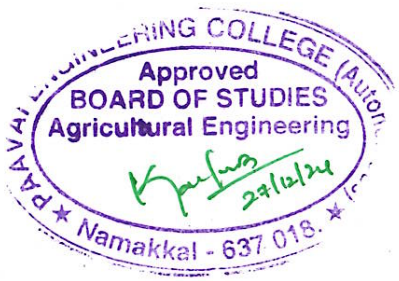
REFERENCES

1. ASTA, "Official analytical methods of the American Spice Trade Association", Fourth Edition, 1997.
2. Purseglove, J.W.,E.G.Brown, G.L.Green and S.R.J.Robbins, " Cardamom – Chemistry". 1981.
3. "Spices, Vol. I, Tropical Agricultural Series", Longman, London, 1:605
4. Pruthi, J.S., "Spices and Condiments: Chemistry, Microbiology and Technology". First Edition. Academic Press Inc., New York, USA. PP. 1-450, 1980.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's(1/2/3/Indicates strength of correlation) 3-Strong,2-Medium,1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	2	3	-	-	-	-	-	-	-	3	2
CO3	2	-	-	2	-	3	3	2	1	-	-	-	3	3
CO4	3	-	2	-	3	-	-	-	-	-	-	-	3	2
CO5	2	-	-	-	-	-	-	1	-	-	-	3	3	-



AI23153	REFRIGERATION AND COLD STORAGE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the underlying principles of operations in different Refrigeration system.
2	know the types of compressors and expansion devices and their applications.
3	interpret principles and operation of vapour absorption refrigeration system.
4	acquire knowledge on Psychrometry.
5	learn the principle of operation in different Air conditioning systems.

UNIT I REFRIGERATION PRINCIPLES **9**

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 - Effect on environmental pollution.

UNIT II VAPOUR COMPRESSION REFRIGERATION AND COMPONENTS **9**

Simple Vapour Compression Cycle - T-S Diagram - P-h Chart- Compressor and condenser – types, construction and working - Expansion device and Evaporators - types, construction and working.

UNIT III VAPOUR ABSORPTION REFRIGERATION AND COMPONENTS **9**

Alternate Refrigerants - Vapour Absorption System- advantages- Ideal Vapour Absorption System- Electrolux Refrigerator - Lithium Bromide Refrigeration-Construction and Principles.

UNIT IV PSYCHROMETRY **9**

Properties of Moist Air, Psychrometric Properties and Measurement - Psychrometric Chart - saturation Line - relative humidity Line - constant Specific Volume Lines - constant Thermodynamic wet bulb temperature Lines - constant enthalpy Lines - Different psychrometric process - Air mixing process and simple air conditioning process - Solving Problems Using Psychrometric Chart.

UNIT V AIR CONDITIONING SYSTEM **9**

Air Conditioning Systems - Winter and Summer Air Conditioning System - Cooling And Heating Coils - Bypass Factor - Effective sensible heat factor, Determination of apparatus dew point (ADP) - Air Distribution System - Room Air Distribution System - Ducts Classification - Evaporative Cooling and its Application - Application of Refrigeration and air conditioning in agriculture.

TOTAL PERIODS **45**

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	gain knowledge on refrigeration principles.	Applying (K3)
CO2	acquire knowledge on vapour compression system and its components.	Applying (K3)
CO3	understand the concepts of refrigerants and vapour absorption cycle.	Understanding (K2)
CO4	know the Psychrometric properties and processes.	Applying (K3)
CO5	attain in-depth knowledge of air conditioning system.	Applying (K3)

TEXT BOOKS

1. R.K. Rajput, "Refrigeration and Air conditioning", Laxmi publication (P) Ltd, New delhi, 2008.
2. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.

REFERENCES

1. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009.
2. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
3. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007.
4. Shan K. Wang, "Handbook of Air Conditioning and Refrigeration", McGraw-Hill Publishers, 2000.

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	2	1	1	-	-	-	-	-	-	-	1	1
CO2	1	2	2	2	1	-	-	-	-	-	-	-	1	1
CO3	2	3	2	1	1	-	-	-	-	-	-	-	3	3
CO4	1	3	2	2	1	-	-	-	-	-	-	-	2	2
CO5	1	3	2	2	1	-	-	-	-	-	-	-	3	3

AI23154	FOOD AND DAIRY PROCESS ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the fundamental knowledge of food , its properties, reaction and kinetics
2	understand about food processing and preservation techniques
3	introduce types of milk, its properties and processing
4	acquire details about manufacturing ,processing and treatment of dairy products
5	gain knowledge of quality control and packaging of food and dairy industries.

UNIT I	PROPERTIES AND THERMAL PROCESSING OF FOOD PRODUCTS	9

Food – Properties, constituents of food; Thermal processing of foods - Cooking, blanching, sterilization, pasteurization, canning; Interaction of heat energy on food components- Reaction kinetics, arrhenius equation, TDT curves, water activity, sorption behaviour of foods, isotherm models, monolayer value; BET isotherms - Raoult's law.

UNITII	ADVANCED PRESERVATION OF FOODS	9

Concentration of foods; Freeze concentration, osmotic and reverse concentration; Drying and Dehydration of food- Tray,Tunnel,belt,vacuum and freeze dryers, rehydration of dehydrated foods; Fat and oil processing-sources, extraction, methods and equipment, refining of oils, hydrogenation; Food preservation methods-preservation by irradiation , microwave ,dielectric heating of food, principles and application.

UNIT III	PROPERTIES AND PROCESSING OF MILK	9

Milk types - Composition and properties of milk, storage tanks, receiving and handling &testing of milk, ; Processing- Straining, filtering and clarification, cream separation, pasteurization, principles and methods-homogenization, principles &methods , UHT processing, applications and aseptic packaging, emulsification, fortification.

UNIT IV	DAIRY PRODUCTS	9

Milk powder -Manufacture, processing of milk products, condensed milk, skim milk ,butter milk, flavored milk; Manufacture of By-products – Whey, casein, yoghurt, paneer, butter, cheese, ghee, ice creams, frozen desserts; Standards for milk and milk products - Characteristics of A1 and A2 milk; Packaging of milk - Milk products, cleaning and sanitation, dairy effluent treatment and disposal.

UNIT V	PACKAGING AND QUALITY CONTROL	9

Food packaging, importance, flexible pouches - retort pouches - aseptic packaging, granules, powder and liquid packaging machines - nanotechnology – principles - applications in food processing. General principles of quality control - Food quality evaluation, food safety, hazards, food toxins, Food adulteration. Standards of food laws-national and international, HACCP.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer thorough knowledge about food, its properties and its kinetics	Understanding (K2)
CO2	identify recent trends in food processing an preservation	Analyzing (K4)
CO3	obtain sufficient knowledge about dairy industries and milk processing techniques	Understanding (K2)
CO4	apply knowledge on manufacturing,proceesing and treatment of dairy products	Applying (K3)
CO5	acquire in depth knowledge on packaging and quality control and evaluation of food and dairy industries.	Applying (K3)

TEXTBOOKS

1. Chandra Gopala rao, "Essentials of Food Process Engineering", B.S.Publications, Hyderabad,2006
2. Walstra.P.,Jan T.M.Wouters., Tomj.Geurt "Dairy Science Technology". CRC press,2005

REFERENCES

1. Subbulakshmi.G and Shobha A.UDIPI, "Food Processing and Preservation", New Age International Publications, New Delhi,2007
2. Toledo, R.T., "Fundamentals of Food Process Engineering", CBS Publishers and distribution, New Delhi, 1997.
3. Tufail Ahamed., "Dairy Plant Engineering and Management", KitabMahal Publishers, Allahabad, 1997.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	-	3	2	-	-	-	-	-	-	3	2
CO3	-	3	-	-	-	2	3	-	-	-	-	2	3	3
CO4	-	-	2	-	-	3	3	-	-	2	3	2	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	2

AI23155	FOOD PROCESS EQUIPMENT AND DESIGN	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart knowledge on basic principles of designing equipment for food processing.
2	become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, drier.
3	provide an idea about devising cold storage units, freezers etc.
4	enhance knowledge on special food processing equipment used for agricultural applications.
5	understand the fundamental knowledge of food, its properties, reaction and kinetics.

UNIT I PROCESS EQUIPMENT DESIGN 9

Introduction on process equipment design; principles and selection of food processing equipment; application of design engineering for processing equipment; overview of different categories of equipment used in food industries; functional requirements and classifications; relevance to product quality and safety.

UNIT II DESIGN PROCEDURE 9

Design parameters and general design procedure, Material specification, Types of material for process equipment, Design codes, Pressure vessel design, Design of cleaners, Importance of material compatibility with food products-safety, durability and cost-effectiveness in equipment material selection.

UNIT III HEAT EXCHANGER 9

Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger Problems on tubular heat exchanger, shell and tube type heat exchanger and plate heat exchanger. Comparison of different heat exchanger types in terms of efficiency and maintenance; selection criteria based on food process requirements.

UNIT IV CONVEYING SYSTEM 9

Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipment; Factors influencing selection of conveying equipment; considerations for hygienic design and energy efficiency.

UNIT V CAD 9

Optimization of design with respect to process efficiency, energy and cost; Computer Aided Design, Overview of manufacturability metrics,GD&T principles and tolerance optimization, Applications of CAD in equipment modeling and simulation; benefits of digital prototyping in food equipment design.

TOTAL PERIODS: 45

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	analyse the various process equipment design	Analyzing (K4)
CO2	understand the design procedure the development of vessels and cleaners.	Understanding (K2)
CO3	analyse the different types heat exchanger methods	Analyzing (K4)

CO4	apply the different methods of conveying system	Applying (K3)
CO5	optimize the variables using CAD for the process equipment design	Applying (K3)

TEXT BOOKS

1. Chakraverty, A" Post Harvest Technology of cereals, pulses and oilseeds" Oxford & IBH publishing Co. Ltd., New Delhi.
2. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.

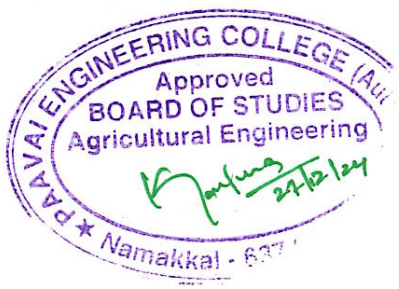
REFERENCES

1. Earle, R.L. "Unit Operations in Food Processing" Pergamon Press. Oxford. U.K.2003
2. Henderson, S.M., and Perry, R. L "Agricultural Process Engineering" Chapman and hall, London.
3. Srivastava, A.C "Elements of Farm Machinery" Oxford and IBH Pub. Co., New Delhi,1990.
4. Sahay, K.M. and Singh, K.K "Unit operations of Agricultural Processing" Vikas Publishing House Pvt. Ltd. New Delhi,1994.

CO PO MAPPING

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	-	3	2	-	-	-	-	-	-	3	2
CO3	-	3	-	-	-	2	3	-	-	-	-	2	3	3
CO4	-	-	2	-	-	3	3	-	-	2	3	2	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	2



AI23156	FOOD PLANT DESIGN AND MANAGEMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart basic knowledge in selecting a location as well as plant design consideration
2	understand the processes involved in plant layout with respect to material handling, space utilization, future expansion
3	understand the importance of availability of raw material requirements and food process equipment construction
4	emphasize the importance of industrial safety, equipment handling and food plant sanitation
5	enrich knowledge for prevention of health hazards and legal aspects in industries

UNIT I	INTRODUCTION PLANT DESIGN AND LOCATION	9

Introduction to food plant design - special features of food and agricultural process industry- Plant Location, Factors affecting plant location and their interaction with plant location. Classification of dairy and food plants, farm level collection and chilling Centre, space requirements. Best practices of hygienic design.

UNIT II	PLANT LAYOUT, EQUIPMENT SELECTION AND UTILITIES	9

Plant Layout: considerations involved in planning an efficient layout - Types of layouts - Advantages of good layout: Development of the pilot layout: Size and structure of the pilot plant- Equipment selection and Utilities: Process equipment - material handling equipment – service equipment- valves and fittings - instruments and controls- considerations involved in equipment selection. Services and Utilities: Estimation of Services such as Cafeteria, locker rooms, water closets, sinks, parking lots, exercise area. Office Layout. Line Balancing and Line balancing Techniques.

UNIT III	FOOD PLANT BUILDING AND CONSTRUCTION	9

Food Plant Building: General requirements and considerations for construction, materials and floors. Drains and drain layout. Ventilation, fly control, mold prevention. Requirements of the steam, refrigeration, water, electricity, Cleaning, sanitization, CIP system, dust removal and fire protection. Materials of construction and colour coding: Characteristics of suitable construction material: Stainless steel, Aluminum, Nickel and Monel, Plastic Materials. Maintenance of Food Plant Building:

UNIT IV	INDUSTRIAL SAFETY AND SAFETY PERFORMANCE	9

Industrial Safety: Process industries, potential hazards, toxic chemicals and physical safety analysis, high pressure, high temperature operation, radioactive materials, safe handling and operation of machineries. Safety Performance: Safety Appraisal, effective steps to implement safety procedures, periodic inspection and safety procedures; proper selection and replacement of handling equipment, personal protective equipments.

UNIT V	ACCIDENTS, HEALTH HAZARDS AND LEGAL ASPECTS	9

Accidents: Industrial accidents–accident costs–identification of accident spots, remedial measures, identification and analysis of causes of injury to men and machines – accident prevention, fire prevention and fire protection. Health Hazards and Legal Aspects: Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – Labour welfare act – ESI Act –Workmen Compensation Act.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	identify suitable plant location and feasibility for food Industries	Applying (K3)
CO2	select suitable plant layout and material selection for food processing industries	Applying (K3)
CO3	infer the requirements of food industry and food process equipment construction	Understanding (K2)
CO4	apply the acquired knowledge for prevention of industrial hazards	Applying (K3)
CO5	outline the health hazards and legal aspects in industries	Understanding (K2)

TEXT BOOKS

1. Sean Moran, "Process plant layout", 2nd Edition, Butterworth-Helnemann, New York, 2017.
2. S.P. Arora and S.P. Bindra, A Text Book of Building Construction, 5th edition, Dhanpat Rai Publications (p) Ltd., New Delhi, 2014.

REFERENCES

1. Basudev panda, "Industrial Safety Health Environment and Security", 1st Edition, Laxmi Publications New Delhi, 2013.
2. George D.Saravacor, Athanasios E.Kostropoulos, "Design Food Processes and Food Processing Plants", 1st Edition, Springer,New York , 2012.
3. Antonio Lopez-Gomez, Gustavov. Barbosa- Canovas, "Food Plant Design", 1st Edition, CRC Press, New Delhi, 2005.
4. G.K. Agarwal, Plant layout and materials handling, Jain brothers, New Delhi, 2008.

CO PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Cos	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	-	-	1	1	-	-	1	-	1	1	3
CO2	3	2	3	-	-	1	2	-	-	1	-	1	1	3
CO3	3	2	3	-	-	3	2	-	-	1	-	2	1	3
CO4	3	1	3	-	-	3	3	-	-	1	-	1	1	3
CO5	3	1	2	-	-	3	2	-	-	1	-	3	1	2

AI23157	EMERGING TECHNOLOGIES IN FOOD PROCESSING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart knowledge about basics concepts in food processing techniques and their applications.
2	understand the processing and preservation of solid and liquid food products.
3	demonstrate the mechanism and its effects on solid and fluid foods products.
4	knowledge about the food safety and shelf life of foods products.
5	describe about the principles and significance of food processing.

UNIT I	PRESSURE AND HEAT TREATMENT	9

Non thermal technologies in preservation of foods, necessity and advantages, status and trends of non-thermal technol. gies in preservation of foods, high pressure treatment of food, governing principles, process equipment; Processing and effect on microorganisms, combined pressure-heat treatment on quality attributes of foods, effect on microorganism, texture, enzyme activity, nutrients, processing of salads and ready meals, high pressure freezing, ultra high static pressure; High hydrostatic pressure processing of cereals and pulses; High pressure CO2 processing of foods.

UNIT II	ULTRASOUND, LIGHT AND MICROWAVE	9

Ultrasound, principle of operation, mechanism of inactivation of microorganisms and enzymes, UV light and pulsed light preservation, principles of operation, microbial inactivation mechanism; Microwave technology-principle, application, sterilization, tempering, drying, puffing, coagulation and other processing applications; Ultrasonic assistance of food freezing, power ultrasonic processing; Electron beam processing of food.

UNIT III	PEF AND OHMIC HEATING	9

Pulsed electric field, Principles of operation, equipment, processing, control parameters, microbial inactivation mechanism, enzyme inactivation, effects on solid and fluid food, nutritional and quality parameters; Ohmic heating, principle, equipment, effect on food quality and microbes inactivation, modelling of ohmic heating, ohmic heating application to Specific foods.

UNIT IV	INNOVATION IN FOOD PACKAGING	9

Introduction to irradiation technologies, general modification, equipment and operational parameters, food safety and shelf in activation life of irradiated liquid foods, osciliating magnetic fields-magnetic files, generation, mechanisms of microorganisms, magnetic fields in food preservation; Infra-red, mechanism of IR absorption by food, IR emitters and spectral bands, applications; induced electric field (IEF), mechanism and application, oscillating magnetic field processing.

UNIT V	OZONE, COLD PLASMA AND RF PROCESSING	9

Generation of ozone, batch and continuous process of ozone for inactivation, factors affecting efficacy of ozone processing, effect on food quality, methods of generation of cold plasma, control parameters, batch and continuous method of cold plasma treatment for decontamination; Radio wave frequency, principle, factors influencing RF heating process, applications.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	understand the principles of high pressure treatment and its effect on microorganisms, texture, enzyme activity, and nutrients in food.	Understanding (K2)
CO2	analyze the effect of sound, light and electro-magnetic waves on processing and preservation of solid and liquid food.	Analysing (K4)
CO3	demonstrate principle, significance of electric current on microbial inactivation mechanism, and its effects on solid and fluid foods.	Applying (K3)
CO4	describe and apply the principles of irradiation technologies, describe on mechanism of preservation, operational parameters, and the impact on food safety and shelf life of foods.	Applying (K3)
CO5	describe and demonstrate principles and significance of ozone, UV and RF for microbial inactivation.	Applying (K3)

TEXT BOOKS

1. Sun,D,."Emerging Technologies for Food Processing",2nd edition,AcademicPress,2014.
2. Gaurav Tewari and Vijay K. Juneja, "Advances in Thermal and Non- Thermal Food Preservation", 2ND edition, Blackwell Publishing. 2020.

REFERENCES

1. Gustavo V. Barbosa-Cánovas, María S. Tapia and M. Pilar Cano, Novel Food Processing Technologies, special Indian edition,CRC Press, 2018.
2. Enrique Ortega-Rivas "Non Thermal Food Engineering Operations. CRC Press, 1st Edition2012.
3. Da –Wen Sun, "Thermal Food Processing: New Technologies and Quality Issues, 2nd Edition, CRC Press/Taylor & Francis, Boca Raton, Florida, USA, 2012.

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	1	-	2	-	-	-	-	-	-	1	2	2
CO2	3	-	2	-	1	1	-	-	-	-	-	1	2	2
CO3	3	-	2	1	1	1	-	1	1	-	-	1	2	2
CO4	3	-	2	1	2	1	-	-	-	-	-	2	2	2
CO5	2	-	2	1	-	-	-	1	-	-	-	2	3	2

AI23251	COMMAND AREA WATER MANAGEMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the fundamentals of minor irrigation, important operation, maintenance and people's participation.
2	learn command area development on farm structures, policy, operation and maintenance.
3	create various practices of farm water management.
4	impart the knowledge on water requirement and utilization.
5	infer the concept of water Requirement of crops.

UNIT I	DESIGN OF IRRIGATION CHANNELS	9

Design of Erodible and Non-Erodible, alluvial channels; Kennedy"s and Lacey"s Theories - Materials for Lining watercourses and field channel - water control and diversion structure.

UNIT II	COMMAND AREA	9

Command area - Concept – CADA programmes in Tamil Nadu; duty of water – expression, relationship between duty and delta, warabandhi; water distribution and rotational Irrigation System; participatory irrigation management.

UNIT III	CONJUNCTIVE USE OF SURFACE AND GROUNDWATER	9

Availability of water - rainfall, canal supply, groundwater; Irrigation demand - water requirement and utilization; Prediction of over and under utilization of water; Dependable rainfall - Rainfall analysis by Markov chain method, Probability matrix.

UNIT IV	WATER BALANCE	9

Groundwater balance model – Weekly water balance; Performance indicators – adequacy, dependability, equity, efficiency; conjunctive use plan by optimization – agricultural productivity indicators.

UNIT V	SPECIAL TOPICS	9

Automation of micro-irrigation system - time based, volume based, Sensor based; National water policy - Institutional aspects - Socio-economic perspective; Reclamation of salt affected soils- Seepage loss in command area; Irrigation conflicts- Water productivity, Water pricing.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	comprehend the control and diversion structure in irrigation system	Understanding (K3)
CO2	elucidate the command area development programme in Tamil nadu & India	Understanding (K2)
CO3	analyse the rainfall and predict ground water resources	Analyse (K4)
CO4	evaluate the Water use efficiency of ground water	Applying (K3)
CO5	interpret national water policy and water productivity	Applying (K3)

TEXT BOOKS

1. Michael, A.M. "Irrigation Theory and Practice", Vikas publishing house, New Delhi, 2006.
2. Modi, P.N., "Irrigation and Water Resources and water Power Engineering", Standard Book House, New Delhi.

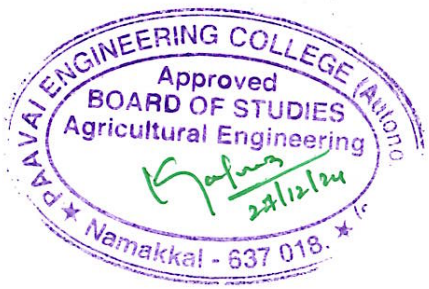
REFERENCES

1. Israelson, "Irrigation Principles and Practices", John Wiley & sons, New York.
2. Suresh, R. "Land and Water Management Principles", Standard Publishers, New Delhi.
3. Michael, A.M. and Ojha, T.P "Principles of Agricultural Engineering" Vol II, New Delhi.
4. Keller.J. and Bliesner D.Ron, 'Sprinkler and Trickle Irrigation", Published by Van No strand Rein hold New York.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	2	3	1	2	-	-	-	2	3	-
CO2	2	-	-	-	-	3	3	-	-	-	1	1	3	-
CO3	1	-	-	2	3	-	2	1	2	-	-	3	3	1
CO4	-	3	-	3	-	-	2	2	-	-	-	1	-	-
CO5	-	-	-	-	3	3	2	2	-	-	2	2	-	3



AI23252	MICRO IRRIGATION SYSTEM	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart knowledge about basics concepts in micro irrigation.
2	introduce the various components of micro irrigation system.
3	understand the design of drip irrigation system.
4	study about design in sprinkler irrigation system.
5	enrich knowledge on advances in micro irrigation system.

UNIT I	MICRO IRRIGATION CONCEPT AND APPLICATIONS	9

Micro irrigation - Comparison between Traditional and Micro irrigation methods, merits and demerits of micro- irrigation system, Types and components of micro irrigation system; Scope and potential problem of micro irrigation; Low-cost micro irrigation Technologies - Gravity fed micro irrigation; Care and maintenance of micro-irrigation System.

UNITII	COMPONENTS OF MICRO IRRIGATION SYSTEMS	9

Pump classification - Variable displacement pumps, Centrifugal pump - Design of impellers and casing, selection of centrifugal pumps, Submersible pump, Vertical Turbine pumps, Jet and Airlift Pumps; Pump selection and installation- troubles and Remedies; Types of valves - Pressure relief valve, Gate valve, Isolated valve, Non return valve, Butterfly valve, Solenoid valves - Selection, repair and maintenance.

UNIT III	DRIP IRRIGATION DESIGN	9

Drip irrigation – Components, Dripper- types and equations governing flow through drippers, Wetting pattern; Fertigation and Herbigation; Pump capacity –Installation, Operation and maintenance of Drip irrigation system; Filtration unit; Design of surface and sub-surface drip irrigation.

UNITIV	SPRINKLER IRRIGATION DESIGN	9

Sprinkler irrigation - Components and accessories; Hydraulic design - distribution pattern, application rate; Droplet size - Sprinkler selection and spacing, Capacity of sprinkler system; Sprinkler types - sprinkler performance, Sprinkler discharge, water distribution pattern; Droplet size, filtering unit and system maintenance.

UNiTV	ADVANCES IN MICRO IRRIGATION	9

Greenhouse irrigation - selection of components - design considerations; Automated irrigation - selection of system and components; Decision support systems - IoT in micro-irrigation; Fertigation - selection of components - design considerations – automation; Economics of micro-irrigation, project cost estimation, cost- benefit analysis, alternate energy for micro-irrigation, adaptive mulching techniques.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer basic concepts in micro irrigation.	Understanding (K2)
CO2	analyze the components in micro irrigation system.	Analysing (K4)
CO3	know the design, operation and maintenance of drip irrigation system.	Understanding (K2)
CO4	gain knowledge on design, operation and maintenance of sprinkler irrigation system.	Understanding (K2)

CO5	apply the new innovation advances in micro irrigation system.	Applying (K3)

TEXT BOOKS

1. Suresh, R., "Principles of Micro-Irrigation Engineering", Standard Publishers Distributors, NewDelhi, 2010
2. Michael, A.M., "Irrigation Theory and Practice", Vikas Publishers, New Delhi, 2002.

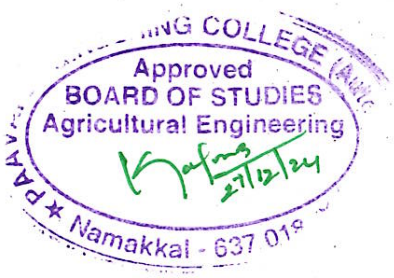
REFERENCES

1. Dilip Kumar Majumdar., Irrigation Water Management, Prentice Hall Inc., 2004..
2. Modi, P.N., and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 1991.
3. Jack Keller and Rond Belisher., "Sprinkler and Trickle Irrigation", Vannistr and Reinhold, New York 1990.
4. Sivanappan R.K., "Sprinkler Irrigation", Oxford and IBH Publishing Co., New Delhi, 1987.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

	(PO's)												PSO'S	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	2	2	1	-	1	-	-	-	2	-	2	2
CO2	1	-	-	2	1	-	-	-	-	-	2	1	2	3
CO3	2	1	2	2	-	1	-	-	-	2	3	1	3	3
CO4	2	1	2	2	1	-	-	-	2	1	2	-	3	2
CO5	1	2	-	2	2	-	-	-	-	1	2	-	2	2



AI23253	IRRIGATION ECONOMICS	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	know the basics concepts of economics.
2	impart knowledge on roles of financial analysis in irrigation.
3	understand the importance of irrigation in Indian agriculture
4	carryout surveys related to sampling secondary data.
5	improve the decision making skills, assess the risk factors in farm management.

UNIT I	ECONOMIC ANALYSIS	9

Problems in project selection. Methods and approaches to water pricing. Criteria for investment and pricing in irrigation projects. Social benefits, problems and causes of under-utilization. Mathematics of economic analysis. Cost allocation, separable and non- separable costs. Discounting factors and techniques. Determination of benefits cost and benefits analysis. Project evaluation; Limitations of benefit-cost analysis; Dynamics of project analysis.

UNITII	ROLE OF FINANCIAL ANALYSIS	9

Distinctions from economic analysis; Financial feasibility and analysis. Impact of public policies on regulation and allocation of irrigation water; Relative economic efficiency of alternative irrigation water management models; Irrigation system improvement by simulation and optimization to enhance irrigation water use efficiency.

UNIT III	IRRIGATION IN INDIAN AGRICULTURE	9

Indian agriculture, main problems, population, government policies, systems, organizing agriculture production; Farm Management- Definition, importance, scope, relation with other sciences and its characteristics.

UNITIV	SOCIO-ECONOMIC SURVEY	9

Importance of such survey in planning, implementation and evaluation of project performance; Planning of socio-economic survey, types of data sets to be collected, preparing the questionnaires form, schedules sampling, editing and scrutinizing of secondary data, classification and analysis of data.

UNITV	RISK ASSESMENT IN IRRIGATION	9

Role of farm management principles in decision making for irrigated agriculture; Decision making process, assessing risk and uncertainty in planning.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	solve the problems related to project selection.	Analyzing(K4)
CO2	understand the role of financial analysis in irrigation management	Understanding (K2)
CO3	handle the farm management system.	Applying (K3)
CO4	apply the socio economic survey in agriculture field.	Applying (K3)
CO5	able to assess the risk assessment in irrigation in agriculture.	Analyzing (K4)

TEXTBOOKS

1. Allan C. Deserpa, "Micro-economic theory – Issues and applications" Allyn and Bacon, Inc. Massachusetts. 1997
2. Paul A. Samuelson and William D. Nordhaus, "Economics" Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2004.

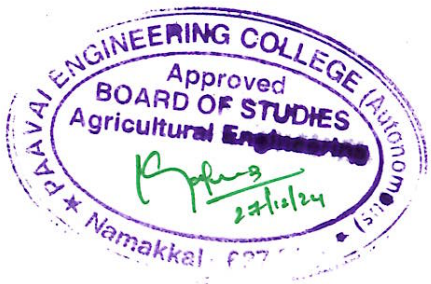
REFERENCES

1. Bilgrami S.A.R. , "An Introduction to Agricultural Economics" Himalaya Publishing House, Mumbai. 2006.
2. Douglas James L and Robert Lee "Economics of Water Resources Planning" Tata McGraw-Hill Publishing Co.Ltd., New Delhi. 1971.
3. Ronald D. Kay, "Farm Management, Planning, Control and Implementation" McGraw-Hill Publishing Co. Ltd.,New Delhi, 2007

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	3	2	1	1	1	2	-	3	2	3	2
CO2	1	2	1	2	1	1	1	1	2	-	2	2	2	2
CO3	3	3	2	2	2	2	1	-	2	-	2	2	3	2
CO4	3	3	2	2	2	-	-	3	2	-	2	2	2	2
CO5	2	1	3	3	2	1	-	-	1	-	3	2	2	2



AI23254	AUTOMATION IN IRRIGATION	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart knowledge about basics concepts concept of Irrigation Automation
2	expose the concepts of Automatic Systems and IoT applications
3	train the students to explore the new technologies in Irrigation system
4	infer the Economic impacts of automation on agricultural farms
5	impart knowledge of the surface and sub-surface methods of automation irrigation system.

UNIT I	INTRODUCTION TO AUTOMATION	9

Automatic Irrigation – definition, need, advantages; methods- traditional methods, innovative methods of irrigation; Comparison between traditional and automated irrigation – Advantages, Disadvantages; Economic Impacts of Automation on Agricultural Firms.

UNIT II	SYSTEMS OF AUTOMATION	9

Pneumatic System- scope, limitations, comparison; Portable timer system - Timer/Sensor Hybrid/SCADA; methods of automating Irrigation layout –types, components, methods, future trends; machine Learning in tank monitoring system.

UNIT III	IoT IN IRRIGATION	9

IoT based Automated Irrigation System – IoT based Smart Irrigation – Sensor based Automation, types, operation Solar based; Automatic Irrigation System – components, operation; Automation by sensing soil moisture - automation using ANN based controller – operation; future of Automation.

UNIT IV	SURFACE AND MICRO-IRRIGATION AUTOMATION	9

Automation and control in Surface Irrigation Systems – Time based automation, flow control based automation, soil moisture controlled automation, Equipment, benefits, barriers; Automation in micro irrigation systems-automation , components , design, cost, operation and maintenance.

UNIT V	ASSESSMENT OF PARAMETERS IN IRRIGATION	9

Crop water estimate using Satellite data – data used, data processing, remote sensing techniques; automation of lysimeter for PET Measurements; Energy based remote Sensing model; remote Monitoring design of automatic irrigation system.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer the technologies available for automation	Understanding (K2)
CO2	evaluate the automated irrigation system to be more efficient	Applying (K3)
CO3	apply the IoT knowledge in Automation and control of Surface Irrigation.	Applying (K3)
CO4	develop and implement the automated irrigation layout.	Applying (K3)
CO5	estimate the cost economics of modern irrigation system	Applying (K3)

TEXT BOOKS

1. H.R.Haise, E.G.Kruse. et al., "Automation of surface irrigation", 15 years of USDA Research and development at fort Collins, Colorado.
2. Brian whahlin and darell zimbelman "Canal Automation for Irrigation Systems", American Society of Civil Engineers, 2014.

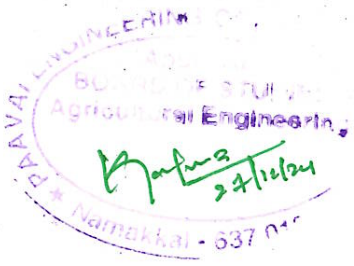
REFERENCES

1. Megh R Goyal and R.K. Srivastava, "Smart irrigation systems", American society of civil Engineers.
2. Darell D.Zimbelman, "Planning, Operation, Rehabilitation and Automation of Irrigation water delivery system" American Society of Agricultural Engineers, 1987.
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 Manufacturing Corporation, Glendora, California., 2001.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	3	2	1	1	2	-	1	3	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	3
CO3	3	-	-	2	-	-	3	-	-	2	-	1	2	3
CO4	3	2	-	-	-	2	1	-	-	-	-	3	2	-
CO5	1	2	-	2	-	1	2	2	1	-	-	2	-	2



AI23255	INTEGRATED WATER RESOURCES AND PARTICIPATORY MANAGEMENT	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1	acquire the fundamental knowledge of IWRM Principles and Framework
2	understand the international law in water management and institutional transformation
3	provide exposure in farmers participation and activities on water towards organization
4	relate the issues in sectoral water allocation and farmers Organisation
5	induce the decision making, leadership and responsibilities to farmers

UNIT I	CONTEXT FOR IWRM	9

Definition of IWRM within the broader context of sustainable development - key elements of IWRM Principles - IWRM framework ; UN World Water Assessment - SDGs in the context of IWRM -Paradigm shift in water management.

UNIT II	LEGAL AND REGULATORY SETTINGS	9

Basic notion of governance: principles of international law in water management - Understanding UN law on non- navigable uses of international water courses; International law for groundwater management - World Water Forums - IWRM in Global, Regional and Local water partnership - Institutional transformation.

UNIT III	UNDERSTANDING FARMERS PARTICIPATION	9

Need and benefits of farmers participation - comparisons of cost and benefit - Water User Association Membership -Kinds of participation - National and international Experiences; Activities on water towards organization and Structure -Context of participation factors in the environment.

UNIT IV	ROLE OF STAKEHOLDERS AND THE UNDERLYING ISSUES	9

Multiple use of water - Issues in sectoral water allocation -Domestic, Irrigation, Industrial sectors -Woman as a water user – Constraints and Opportunities; Role of Community Organisers- Water user association - Constraints in Organising farmers Organisation.

UNIT V	IMPROVING AGENCY RELATIONS AND INSTITUTIONAL REFORMS	9

Supporting farmer organization and participation -Decision making - Leadership and responsibilities Development strategy - channels for implementation - Equity and equality - Agency incentives, technical co - operation, special roles, Agency roles - institutional Reforms

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	compute the IWRM within the broader context of sustainable development	Understanding (K2)
CO2	examine the global, regional and local water partnership and institutional transformation	Understanding (K2)
CO3	adopt the farmers participation and activities on water towards organization	Applying (K3)
CO4	solve the issues and constrains of farmers organisation	Analyzing (K4)
CO5	elect the leaders from the farmers organisation and agency incentives	Applying (K3)

TEXT BOOKS

1. Mollinga .P. etal "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications,2006.
2. Uphoff. N., Improving International Irrigation management with Farmer Participation - Getting the process Right - Studies in water Policy and management, New West - View press, Boulder and London, 2013.

REFERENCES

1. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
2. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc.,New York. 2003.
3. Michael C.M., Putting people first, Sociology variables in Rural Development, Oxford University press, London 1985.
4. Sivasubramanium K., Water Management SIMRES Publication, Chennai 2009.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	(PO's)												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	1	-	2	-	-	-	-	-	-	3	2
CO2	2	3	2	1	-	2	-	-	1	2	-	1	-	2
CO3	2	3	2	-	-	3	-	1	2	-	-	1	2	2
CO4	2	3	3	2	-	3	-	1	2	2	-	1	2	2
CO5	2	3	3	2	-	2	-	-	2	2	-	1	2	2

AI23256	IRRIGATION WATER QUALITY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	know the basics concepts of irrigation water quality
2	impart knowledge on water quality for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts.
3	understand the importance of water quality for irrigation and major uses of water and the role environmental issues.
4	carryout surveys related to sampling secondary data.
5	improve the decision making skills, assess the risk factors in farm management.

UNIT I	WATER QUALITY	9

Physical and chemical properties of water - Suspended and dissolved solids - EC and pH - major ions -Water quality investigation - Sampling design - Samplers and automatic samplers - Data collection platforms - Field kits - Water quality data storage, analysis and inference - Software packages

UNITII	IRRIGATION WATER QUALITY	9

Water quality for irrigation - Salinity and permeability problem - Root zone salinity - Irrigation practices for poor quality water - Saline water irrigation - Future strategies.

UNIT III	WATER POLLUTION	9

Sources and Types of pollution - Organic and inorganic pollutants - BOD – DO relationships - impacts on water resources - NPS pollution and its control - Eutrophication control - Water treatment technologies - Constructed wetland.

UNITIV	RECYCLING AND REUSE OF WATER	9

Multiple uses of water - Reuse of water in agriculture - Low cost waste water treatment technologies - Economic and social dimensions - Packaged treatment units - Reverse osmosis and desalination in water reclamation.

UNITV	WATER QUALITY MANAGEMENT	9

Principles of water quality - Water quality classification - Water quality standards - Water quality indices - TMDL Concepts - Water quality models.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the parameters of water quality	Understanding (K2)
CO2	assess the concepts of water quality for irrigation	Analyzing (K4)
CO3	analyze water pollution and its quality considerations	Analyzing (K4)
CO4	understand the recycling and reuse of water	Understanding (K2)
CO5	handle the management of water quality	Applying (K3)

TEXTBOOKS

1. George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, "Waste water Engineering: Treatment and Reuse", McGraw-Hill, 2002
2. Vladimir Novonty, "Water Quality: Diffuse pollution and watershed Management", 2nd edition, John Wiley & Sons, 2003

REFERENCES

1. Mackenzie L Davis, David A Cornwell, "Introduction to Environmental Engineering", McGraw-Hill 2006.
2. Stum, M and Morgan, A., "Aquatic Chemistry", Plenum Publishing company, USA, 1985
3. Lloyd, J.W. and Heathcote, J.A., "Natural Inorganic Chemistry" in relation to groundwater resources, Oxford University Press, Oxford, 1988.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	3	2	1	1	1	2	-	3	2	3	2
CO2	1	2	1	2	1	1	1	1	2	-	2	2	2	2
CO3	3	3	2	2	2	2	1	-	2	-	2	2	3	2
CO4	3	3	2	2	2	-	-	3	2	-	2	2	2	2
CO5	2	1	3	3	2	1	-	-	1	-	3	2	2	2

AI23257	WATERSHED PLANNING AND MANAGEMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart knowledge on various of watershed characteristics.
2	acquire the knowledge about the principles in planning of watershed.
3	provide a comprehensive treatise on engineering practices in watershed management.
4	understand the importance of water conservation practices.
5	acquire the knowledge about the watershed development activities.

UNIT I	INTRODUCTION	9

Watershed – Definition - concept – Objectives, Classification ; Watershed Characteristics; Priority watershed - Concepts- Factors Influencing Prioritizing watershed -Purpose and benefits for watershed prioritizations; Land capability classification –Classes ,Subclasses ; Land Resources Region in India ; Watershed Based Land Use Planning-Watershed Atlas.

UNITII	WATERSHED PLANNING	9

Planning principles – Importance of watershed Planning -Steps in watershed planning- Data Required for Watershed Planning– Preparation of watershed development plan ; Estimation of costs and benefits ; Selection of implementation agency ; Monitoring -Importance-Monitoring tools ; Evaluation system -Stages –Indicators.

UNIT III	WATERSHED MANAGEMENT	9

Watershed Management - Concepts and advantages ; Participatory watershed Management ; Run off management - Factors affecting runoff ; Temporary & Permanent gully control measures ; Use of Aerial photography and Remote sensing in watershed management.

UNIT IV	WATER CONSERVATION PRACTICES	9

In-situ & Ex-situ soil moisture conservation principle and practices ; Irrigated lands - Dry lands ; Micro catchment-Methods; Water harvesting- methods-components; Ground water recharge -Factors affecting; Farm pond- Methods-Selection ; Percolation pond , Supplemental irrigation; Evaporation suppression - Methods; Seepage reduction ; Afforestation - Importance.

UNIT V	WATERSHED DEVELOPMENT PROGRAMME	9

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) -Integrated watershed development programme (IWDP)- Drought Prone Project- Desert Development programme ; Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development ; Role of NGOs in watershed development.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	assess the watershed characteristics for their classification and prioritization.	Analyzing(K4)
CO2	execute the watershed planning activities based on the inventory and scope.	Analyzing(K4)
CO3	find the needs, methods and implementation strategies of watershed management.	Applying (K3)
CO4	assess the watershed response for suggesting suitable control measures.	Analyzing(K4)
CO5	organize the watershed development programme.	Applying (K3)

TEXT BOOKS

1. Suresh R, "Land and water management principles", Standard Publishers & Distributors, New Delhi, 2008
2. Das M, Saikia MD, "Watershed management", PHI Learning, 2013.

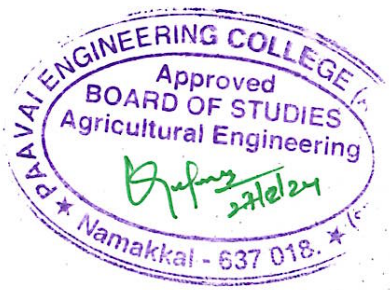
REFERENCES

1. Brooks KN, Folliott PF,"Hydrology and the Management of Watersheds", Wiley-Blackwell, Ames, 2013.
2. Ghanashyam Das, "Hydrology and Soil Conservation engineering", Prentice Hall of India Private Limited,2000.
3. K. Palanisami, V. N. Sharda , "Water management in the Hill regions ", Bloomsbury Publishing Pvt.Ltd,2013.
4. Singh, Raj Vir.,"Watershed planning and management. India" Yash Publishing House, 2000.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S)
(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	-	-	2	3	1	-	-	-	-	-	1	-
CO2	1	2	-	-	1	3	2	-	-	-	-	-	2	-
CO3	1	1	-	-	1	2	3	-	-	-	-	-	1	-
CO4	1	2	3	-	2	1	2	-	-	-	-	-	3	-
CO5	1	1	-	-	3	1	2	-	-	-	-	-	1	-



AI23351	PRECISION FARMING EQUIPMENT	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1	extent the fundamental knowledge of precision agriculture and tools with aids of GIS and GPS
2	understand the various sensors and microcontroller used in precision agriculture
3	provide exposure in operations of various precision farming machinery
4	impart knowledge about nutrient, weed and yield management, soil analysis
5	relate the unmanned agricultural vehicles and controlled atmospheric cultivation practice

UNIT I	ROLE OF ELECTRONICS IN AGRICULTURAL ENGINEERING	9

Electronics in precision agriculture - Basics of precision agriculture - Tools for implementation of precision agriculture; Introduction of mapping system for precision farming; Use of GIS and GPS in farm machinery and equipment.

UNIT II	SENSORS, MICROCONTROLLER AND ACTUATOR FOR PRECISION AGRICULTURE	9

Types of sensor - principle and concept of different sensor like ultrasonic, proximity, PIR, IR, radar, pressure, gas, temperature, moisture, strain /weight, colour sensor etc. used in agriculture; Microcontroller - Ardino, Raspberry Pi and PLC Actuator ; DC Motor, Pump, linear Actuator etc. - Basic input circuits and signal conditioning systems - amplifiers and filters.

UNIT III	PRECISION FARMING CONCEPTS AND PRECISION FARMING MACHINERY	9

Precision farming concepts - sensor based system - Combination Map and real time system; Components of PF – Precision tillage, planting, intercultural, plant protection and harvesting equipment, laser guided leveller, power sprayer, straw chopper cum spreader, straw bailer.

UNIT IV	SITE-SPECIFIC MANAGEMENT SYSTEM	9

Site - specific nutrient management- weeds management- Agro-chemicals and fertilizer management; Data sources and decision making for site-specific management; Grain quality and yield - Yield monitoring and mapping - soil sampling and analysis.

UNIT V	UNMANNED VEHICLES AND IOT IN AGRICULTURE	9

UAV - Drones - types, applications, rules and regulations - Autonomous ground vehicles - Robotic platforms and unmanned agricultural vehicles- IoT; crop yield estimates-threat identification; controlled atmospheric cultivation practice- components, characteristics, yield parameters.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	develop the ideas in fundamental of precision agriculture and tools	Understanding (K2)
CO2	compute the assembling procedure of sensors and microcontroller used in precision agriculture	Understanding (K2)
CO3	adopt the suitable precision farming machinery	Applying (K3)
CO4	analyse the nutrient, weed and yield management, soil analysis	Analyzing (K4)
CO5	examine the concepts of unmanned agricultural vehicles	Applying (K3)

TEXTBOOKS

1. Hermann, J.H. 2013. "Precision in Crop Farming, Site Specific Concepts and Sensing Methods: Applications and Results" Springer, Netherlands.
2. Krishna, K. R. 2016. "Push Button Agriculture Robotics, Drones, Satellite-Guided Soil and Crop Management" Apple Academic Press.

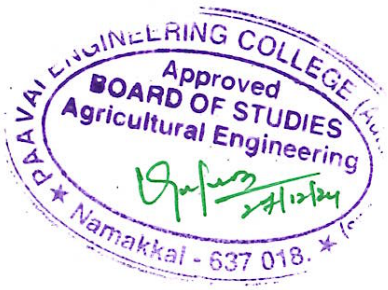
REFERENCES

1. Michael, A.M. 2007. "Irrigation: Theory and Practice", Vikash Publishing House Pvt. Ltd., New Delhi.
2. Brase, T.A. 2006. "Precision Agriculture", Thomson Delmar Learning, New York.
3. Zhang, Q. 2015. "Precision Agriculture Technology for Crop Farming", CRC Press, New York.
4. Srivastava,A K., Carroll E.G., Roger P. R. and Dennis R.B.2006. "Engineering Principles of Agricultural Machines" American Society of Agricultural and Biological Engineers, USA.

CO-PO MAPPING

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

	(PO's)												PSO'S	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	1	1	3	-	-	-	-	-	-	3	2
CO2	3	2	3	2	3	3	-	-	-	-	-	1	2	3
CO3	3	3	3	1	2	3	-	-	-	-	-	1	3	3
CO4	3	3	2	2	2	3	2	-	-	-	-	1	2	3
CO5	2	3	2	2	2	3	2	-	-	-	-	1	2	3



AI23352	INDUSTRIAL SAFETY MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the introduction and basic terminologies safety.
2	enable the students to learn about the important statutory regulations and standards.
3	acquire knowledge in students to conduct and participate the various safety activities in the industry.
4	knowledge about workplace exposures and hazards.
5	assess the various hazards and consequences through various risk assessment techniques.

UNIT I	SAFETY TERMINOLOGIES	9

Hazard-types of Hazard- Risk-Hierarchy of Hazards Control Measures- Threshold Limit Value (TLV) -Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic effects- Routes of chemical entry-Personnel protective equipment- Health and safety policy.

UNIT II	STANDARDS AND REGULATIONS	9

Hazardous materials and welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998-Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III	SAFETY ACTIVITIES	9

Responsibilities of safety officers and safety representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency action plan- Safety poster and display- Human error assessment.

UNIT IV	WORKPLACE HEALTH AND SAFETY	9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Electrical Hazards.

UNIT V	HAZARD IDENTIFICATION TECHNIQUES	9

Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the basic concept of safety.	Understanding (K2)
CO2	obtain knowledge of statutory regulations and standards.	Understanding (K2)
CO3	know about the safety activities of the working place.	Applying (K3)
CO4	analyze on the impact of occupational exposures and their remedies	Applying (K3)
CO5	obtain knowledge of risk assessment techniques.	Applying (K3)

TEXT BOOKS

1. R.K. Jain and Prof. Sunil S. Rao "Industrial Safety, Health and Environment Management" Systems Khanna Publisher.

2. L. M. Deshmukh "Industrial Safety Management: Hazard Identification and Risk Control" McGraw-Hill Education.

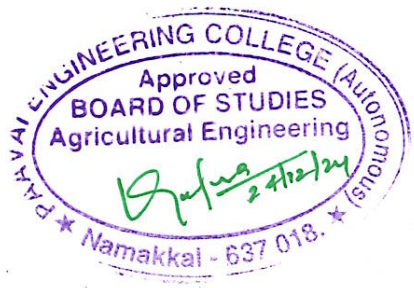
REFERENCES

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries, Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) "Techniques of Safety Management: A System Approach".
4. Alan Waring (1996) "Safety management system" Chapman &Hall, England Society of Safety Engineers. USA.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	1	1	3	2	2	3	3	1	3	3	3
CO2	2	3	2	2	1	3	2	3	3	2	1	3	3	3
CO3	2	2	2	2	1	2	2	2	3	2	1	2	3	3
CO4	3	3	3	2	2	3	2	2	3	2	1	3	3	3
CO5	3	2	3	2	2	3	2	2	3	2	2	3	3	3



AI23353	LAND GRADING AND EARTH MOVING MACHINERY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the fundamental principles of earth-moving machinery.
2	explain the mechanisms of crawler-mounted tractors and dump trucks.
3	examine the role of rubber tires in earth-moving machinery for mobility and performance.
4	evaluate the role of graders in land development projects.
5	conduct economic analysis of land development machinery.

UNIT I	FUNDAMENTALS OF EARTH-MOVING MACHINERY AND SOIL BEHAVIOR	9

Engineering fundamentals related to earth-moving machinery - principles of operation and design. Detailed study of soil behavior such as swell, shrinkage, and compaction - Practical measurement techniques. Examination of tractors and crawlers -Focusing on the impact of altitude - temperature - performance and efficiency.

UNITII	GRADING AND CRAWLER MECHANISMS	9

Techniques and equipment used for grading sloped lands with a focus on precision and efficiency. Detailed mechanisms and functionalities of crawler-mounted tractors. In-depth study of dump trucks, their loading and unloading mechanisms, and their role in earth-moving operations.

UNIT III	LAND CLEARING EQUIPMENT AND MOBILITY SOLUTIONS	9

Overview of land clearing and reclamation equipment, including their applications and operational principles. Study of power shovels, draglines, and clam shells, emphasizing their design and usage. Analysis of the role of rubber tires in enhancing the mobility and performance of earth-moving machinery.

UNITIV	EARTH-DIGGING, TRENCHING, AND GRADING MACHINERY	9

Study of earth-digging and ditching equipment, with applications in excavation projects. Detailed working mechanisms and operational uses of bulldozers and scrapers. Examination of elevating graders, self-powered graders, trenching machinery, and their role in construction and land development.

UNITV	BORING TECHNIQUES, AND ECONOMIC ANALYSIS OF MACHINERY	9

Introduction to automation technologies in earth-moving and grading machines for improved accuracy and productivity. Study of boring machines, including operational methods and applications. Comparative analysis of different boring techniques and their economic implications in land development machinery.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	explain the operational principles of earth-moving equipment.	Understanding (K2)
CO2	illustrate the principles behind land grading techniques.	Analyzing (K4)

CO3	analyze the advantages of rubber-tired machinery for specific applications.	Analyzing (K4)
CO4	evaluate the effectiveness of elevating graders in land preparation.	Understanding (K2)
CO5	conduct cost-benefit analysis to propose economically viable solutions.	Applying (K3)

TEXTBOOKS

1. Dutta S K. 1987 "Soil Conservation and Land Management, International Distributors", Dehradun
2. Sigma and Jagmohan. 1976 " Earth Moving Machinery" Oxford and IBH.

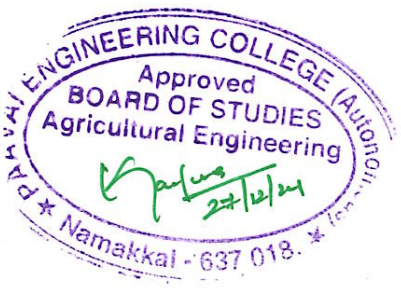
REFERENCES

1. Wood and Stuart. 1977 "Earth Moving Machinery" Prentice Hall.
2. Nicolas H L, Day D H. 1998 "Moving the earth, The work book of excavation" McGraw Hill
3. S.C. Sharma, S.V. Deodhar 2000: "Construction Engineering and Management"

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	3	2	1	1	1	2	-	3	2	3	2
CO2	1	2	1	2	1	1	1	1	2	-	2	2	2	2
CO3	3	3	2	2	2	2	1	-	2	-	2	2	3	2
CO4	3	3	2	2	2	-	-	3	2	-	2	2	2	2
CO5	2	1	3	3	2	1	-	-	1	-	3	2	2	2



AI23354	SPECIAL FARM MACHINERY AND EQUIPMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart knowledge about basics concepts in mowers and weeding equipment
2	understand the functional aspects of sprayers and dusters
3	explain the working principles of threshers and harvesters.
4	develop innovative learning in multi crop thresher and forest machineries
5	enhance knowledge on special machineries used for agricultural applications

UNIT I	MOWERS AND WEEDING EQUIPMENT	9

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 II	SPRAYERS AND DUSTERS	9

Sprayers – Sprayer operation – boom sprayer - precaution - coverage - factors affecting drift. Rotating disc sprayers - Controlled Droplet Application (CDA) - Electrostatic sprayers - Areal spraying - Air assist sprayers - orchard sprayers - Dusters - types - mist blower cum duster - other plant protection devices, care and maintenance

UNIT III	THRESHERS AND HARVESTERS	9

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 IV	THRESHERS AND OTHER MACHINERIES	9

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 V	SPECIALIZED FARM EQUIPMENT	9

Pneumatic planters - air seeders - improved ploughs - reversible ploughs - suction traps - seed and fertilizer broadcasting devices, manure spreaders, sweep weeders - direct paddy seeders, direct paddy cum daincha seeder, coconut tree climbing devices, tractor operated hoist, tractor operated rhizome planter - Transplanters and Balers.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	gather basic concepts in mowers and weeding equipment	Understanding (K2)
CO2	understand the operations of various of sprayers and dusters	Understanding(K2)
CO3	gain sufficient knowledge on working of threshers and harvesters.	Applying (K3)
CO4	develop the various multi crop thresher and forest machineries with their innovative ideas	Applying (K3)

CO5	build thorough knowledge on special farm equipment required for various agricultural operations	Applying (K3)

TEXT BOOKS

1. Jagdishwar Sahay. 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.
2. Michael and Ojha. 2005. Principles of Agricultural Engineering. Jain brothers, New Delhi.

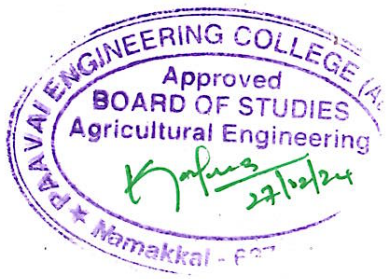
REFERENCES

1. Kepner, R.A., et al. 1997. Principles of farm machinery. CBS Publishers and Distributers, Delhi.
2. Harris Pearson Smith et al. 1996. Farm machinery and equipments. Tata McGraw-Hill pub., New Delhi.
3. Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	1	-	2	1	1	1	-	-	1	1	2	2
CO2	3	-	1	-	1	1	1	-	1	-	-	1	2	2
CO3	3	2	1	-	1	1	1	1	1	-	2	1	2	2
CO4	3	2	1	-	2	1	1	-	-	2	2	1	2	3
CO5	3	-	1	-	1	1	1	1	-	-	-	1	2	2



AI23355	PLANT PROTECTION EQUIPMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart basic knowledge of insect pest and their losses caused to crops.
2	acquire knowledge on pest and disease management in Agricultural and Horticultural crops.
3	study about the different spraying equipment and dusters.
4	explain the working principles of spraying equipment.
5	explain about testing and evaluation of sprayers and dusters.

UNIT I	GROUPS OF INSECTS AND DISEASE	9

Sucking pests, borer pests, soil pests, Vectors, Rodent pests and their symptoms of damage- Fungal bacterial and viral pathogens causing crop disease.

UNIT II	AGRICULTURE AND HORTICULTURE CROP PESTS AND MANAGAMENT	9

Agricultural crops - Rice, pulses, cotton, sugarcane - Horticultural crops - coconut, fruits, vegetables and flower crops affected by various pests and disease. Cultural, physical, mechanical, legal, biological, chemical and biotechnological methods of crop protection, IPM.

UNIT III	INTRODUCTION TO SPRAYERS	9

Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. Calculations for calibration of sprayers and chemical application rates. Introduction to intercultural equipment.

UNIT IV	DESIGN AND CONSTRUCTION OF SPRAYERS	9

Spraying and dusting equipment: atomising devices & pumps for sprayers, constructional details -Boom-type field sprayers - High-pressure orchard and general purpose sprayers -Air-blast sprayers which utilize an air stream as a carrier for sprays -Air-craft sprayers -Granular applicators.

UNIT V	TESTING OF SPRAYERS	9

Testing and Evaluation of Sprayers, Dusters - IS Test Codes, ISO Standards - Procedures - Instruments - Efficiency, Spray Patternator - Spray Droplet Analysis

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	possess knowledge on various groups of insect pests and diseases of crops and symptoms.	Understanding (K2)
CO2	acquire knowledge on different methods of pest and disease management in agricultural and horticultural crops.	Analyzing (K4)
CO3	analyze the different spraying and dusting equipment techniques.	Understanding (K2)
CO4	identify working principles of spraying and dusting equipment.	Understanding (K2)
CO5	analyze the testing and evaluation of sprayers and dusters.	Applying (K3)

TEXT BOOKS

1. Ragupathy. A and B. Ayyasamy 2003. A Guide on Crop Pests. Namrutha Publications, Madanandapuram, Porur, Chennai 16. p.368
2. Mehta M L, S K Singh, S R Verma, Pradeep Rajan. Testing And Evaluation of Agricultural Machinery 2nd Revised & Enlarged Edn. Daya Publishing House.

REFERENCES

1. TNAU, Crop Pests and Stored Grain Pests and Their Management. Agri moon.com
2. Justin.K.2004 Crop protection. TNAU. Pechiparai, Kanyakumari
3. Kepner, R.A., "Principles of farm machinery". CBS Publishers and Distributers, Delhi. 99. 1997.
4. Harris Pearson Smith., "Farm machinery and equipment". Tata McGraw-Hill pub., New Delhi, 1996.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	-	-	-	2	-	-	-	-	2	2	1
CO2	2	1	1	-	-	-	2	-	-	-	-	2	2	2
CO3	2	1	3	-	2	-	-	-	-	-	-	2	3	3
CO4	2	1	3	-	2	-	-	-	-	-	-	2	3	2
CO5	2	1	3	-	2	-	-	-	-	-	-	2	3	1

AI23356	TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	learn the procedure for testing of tractors and all other agricultural equipment and machinery
2.	understand test codes of various countries for testing farm machinery and implements
3.	learn out testing of tractors and all other agricultural equipment and machinery
4.	analyse the performance of farm machinery and implements
5.	get an idea about the mechanization for different crops

UNIT I	TESTING OF AGRICULTURAL TRACTORS	9

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 II	TESTING OF TILLAGE AND SOWING EQUIPMENT	9

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 III	TESTING OF INTERCULTURAL EQUIPMENT	9

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 IV	TESTING OF COMBINE HARVESTER	9

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 V	SAFETY TESTING OF AGRICULTURAL MACHINERY	9

Types of agricultural machinery accidents - causes of agricultural machinery accidents - technical measurements for ensuring safety - methods of safety testing- ROPS and FOPS -safety precautions

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the basics of testing procedures and standards of tractor testing	Understanding(K2)
CO2	experiment the testing procedures and standards of intercultural equipment	Applying (K3)
CO3	make use of the testing procedures and standards of harvesting equipment .	Applying (K3)
CO4	simplify the safety standards and testing procedures	Analyzing (K4)
CO5	understand the testing procedures and standards of tillage, sowing equipment	Understanding (K2)

TEXT BOOKS

1. " Indian Standards Test Codes" related to tractors, power tillers and agricultural implements
2. Michael and Ojha, "Principles of Agricultural Engineering", Jain brothers, 2005..

REFERENCES

1. Kepner, R.A., et al. 1997 "Principles of farm machinery" CBS Publishers and Distributers, Delhi.
2. Harris Pearson Smith et al. 1996 "Farm machinery and equipments" Tata McGraw-Hill pub., New Delhi.
3. Srivastava, A.C. 1990 "Elements of Farm Machinery" Oxford and IBH Pub. Co., New Delhi
4. "Nebraska Tractor Test Codes for Testing Tractors", Nebraska, USA.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	3	-	-	-	-	2	-	1	-	3	-
CO2	3	-	-	3	-	-	-	-	-	1	2	-	-	3
CO3	2	-	-	-	-	-	-	3	-	2	-	-	3	-
CO4	-	-	-	-	-	-	-	-	-	3	2	-	-	3
CO5	3	-	-	-	-	-	-	-	-	-	3	-	2	3

AI23357	MECHANICS OF TILLAGE AND TRACTION	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	impart the fundamental knowledge of mechanics on various tillage implements.
2	study of dynamics in various tillage implements.
3	understand the traction and its mechanism.
4	understand the function of tires and its testing.
5	acquirethe knowledge of application of tillage and traction.

UNIT I	MECHANICS OF TILLAGE	9

Tillage -history-soil machine Crop System ; Mechanics of tillage tools ; Engineering Properties of soil -Physical and mechanical properties of soils-Assessment of Dynamic properties of soil.

UNITII	DYNAMICS OF TILLAGE	9

Design of tillage tools-Design factors -Shape –Macro shape-Principles of soil cutting ; Design equation–dimensional analysis- application of dimensional analysis in soil.

UNIT III	TRACTION	9

Introduction to traction and mechanics- Off road traction and mobility - Traction model , Traction testing, Traction Improvement and Traction Prediction.

UNITIV	TYRES	9

Tires-Type size and its effects of tyre pressure ;tires for agricultural tractors- Tires terminology and selection of tires-Ballasting - Tyre testing.

UNITV	APPLICATION	9

Soil Compaction and plant Growth - mechanical and hydraulic properties of compacted ; Soil physical properties and plant Growth measures for optimizing crop growth by avoiding excessive ; Soil compaction - variability and geo statistics ; Application of GIS in soil dynamics.

	TOTALPERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the concept of mechanics	Applying (K3)
CO2	analyze the principles dynamics and traction	Analyzing(K4)
CO3	apply the mechanism of traction implements	Applying (K3)
CO4	acquire knowledge on tyres and its testing.	Analyzing(K4)
CO5	apply the tillage and traction for soil compaction and plant growth optimization	Applying (K3)

TEXT BOOKS

1. Klenin.N.L.Popov,I.F and V.A.Sakum, "Agricultural mechanics ", Amerind Pub.Co,Newyork,1985.
2. Kepner,R.A.,Roy Bainer and E.L.Barger, "Principles of farm machinery", Third edition, AVI Publishing company Inc ; Westport , Connecticut ,1978.

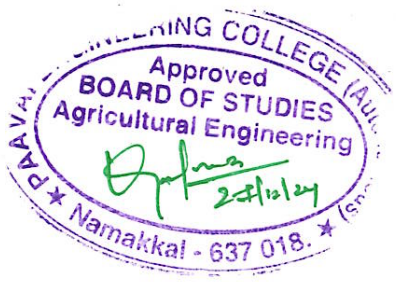
REFERENCES

1. Dr.D.Anantha Krishnan.,Dr.Ananthachar., "Mechanics of Tillage and Traction" Agri Moon.com,2023
2. Ralph Alcock., "Tractor Implements system" , AVI Publications,1986.
3. E. McKyes., "Soil Cutting and Tillage", Elsevier Science,9780444601049, 044460104X,1985.
4. William.R.Gill.,Glen.E.Vanden Berg., "Soil Dynamics in Tillage and Traction" Agricultural Research Service, U.S. Department of Agriculture,2008.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	-	-	-	3	-	-	-	2	-	1	1	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	-
CO3	3	1	-	2	-	-	3	-	-	2	-	1	2	-
CO4	3	2	-	-	3	2	-	-	-	-	-	3	2	-
CO5	3	2	-	-	3	2	-	-	-	-	-	3	2	-



AI23451	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquire the importance of land resources for sustainability.
2	classify the significance of water resources for sustainable development.
3	comprehend organic farming methods in the context of sustainable agriculture.
4	analyze the importance of food security and ecological balance.
5	analyze of policies and programmes that support sustainable agriculture

UNIT I	**LAND RESOURCE**	**9**

Land Resources of India - Classification of land; Population and land; Land utilization; Net Area Sown; Changes in cropping pattern - Factors Affecting Cropping Patterns, Factors Determining Cropping Pattern in India; Land degradation - Remedies of Land Degradation.

UNIT II	**WATER RESOURCE**	**9**

Rainfall forecasting - Characteristics of Rainfall in India, Characteristics of Monsoon in India; Adequacy of rainfall for crop growth - Seasons of India, Season and crop adaptation in India; Drought and production instability; Irrigation potential; River basins; Watersheds; Conjunctive use of ground water and surface water.

UNIT III	**SUSTAINABLE AGRICULTURE AND ORGANIC FARMING**	**9**

Agro-ecosystems; Impact of climate change on agriculture; Effect on crop yield and soil fertility; Food grain production at State Level; Indicators of sustainable food availability; Natural farming principles; Sustainability in rain fed farming; Organic farming - principles and practices.

UNIT IV	**FOOD PRODUCTION AND FOOD SECURITY**	**9**

Performance of major food crops over past decades; Trends in food production; Decline in total factor productivity growth; Demand and supply projections; Market impact - Rural land market, emerging water market; Sustainable food security indicators and index; Path to sustainable development; Vertical farming.

UNIT V	**POLICIES AND PROGRAMMES**	**9**

Food and crop production policies - Agricultural credit policy, Crop insurance, Policies of natural resource use, Policies for sustainable livelihoods; Virtual water and trade; Sustainable food security action plan and implementation; Case Study - Food safety policies and implementation.

	TOTAL PERIODS	**45**

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the importance of land resources in sustainable agriculture	Understanding (K2)
CO2	summarize the role of water resources in agricultural sustainability	Understanding (K2)
CO3	demonstrate the principles of organic farming for sustainable agricultural practices	Applying (K3)
CO4	analyze the concept and need for food security	Analyzing (K4)
CO5	examine the policies and programmes supporting sustainable agriculture	Analyzing (K4)

TEXT BOOKS

1. M.S. Swaminathan "Science and Sustainable Food Security". World Scientific Publishing Co., Singapore. 2010
2. B.K. Desai and B.T. Pujari. "Sustainable Agriculture: A Vision for Future". New India Publishing Agency, New Delhi. 2007

REFERENCES

1. Swarna S. Vepa et al. "Atlas of the Sustainability of Food Security". MSSRF, Chennai. 2004
2. Patra, A. K "Sustainable agriculture: Concepts and approaches". NIPA. 2023
3. Tanji, K. K., & Yaron, B. "Management of water use in agriculture" (Special Indian ed.) Springer-Verlag. 2020
4. Ramasamy, C., and Selvaraj, K.N. "Food Security and Sustainable Agriculture in India: The Way Forward" Tamil Nadu Agricultural University (TNAU), Coimbatore. 2002

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S)
(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	2	2	–	2	2	–	–	–	–	1	3	2
CO2	2	1	1	2	1	2	3	–	–	–	–	1	3	1
CO3	2	1	3	2	1	1	3	2	–	1	–	2	2	3
CO4	2	1	2	2	1	2	3	1	1	1	–	1	2	3
CO5	2	1	2	–	3	2	2	1	1	1	–	2	3	2

AI23452	PROTECTED CULTIVATION AND PRECISION FARMING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	identify various types of protected cultivation systems and their significance in modern agriculture.
2	understand the Hi-tech protected cultivation of vegetable crops.
3	illustrate hi-tech protected cultivation techniques for commercial flower crops.
4	analyze precision farming tools such as GIS, GPS, sensors, and AI for efficient crop management.
5	demonstrate crop-specific precision farming strategies for improved productivity and sustainability.

UNIT I	PROTECTED CULTIVATION AND ITS TYPES	9

Protected cultivation - Scope and Importance; Growing structures - Green house, Poly house, Net house, Poly tunnels, Screen house, Protected nursery house; Environmental factors influencing greenhouse production; Covering material -Cladding, Glazing -Ventilation systems; Growing media - Soil and Soilless; Nutrient film technique; Hydroponics, Aeroponics, Aquaponics; Canopy management; Micro irrigation and Fertigation systems.

UNIT II	PROTECTED CULTIVATION OF VEGETABLE CROPS	9

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 III	PROTECTED CULTIVATION OF FLOWER CROPS	9

Protected cultivation technology for flower crops: Hi-tech protected cultivation of Roses, Chrysanthemum, Carnation, Gerbera, Anthurium, Orchids, Cut foliage's and fillers; Integrated pest and disease management; Post-harvest handling.

UNIT IV	PRECISION FARMING TECHNIQUES	9

Precision farming – Introduction, Concept and Importance, Role of GIS and GPS; Mobile mapping system and its application in precision farming; Design, layout and installation of drip and fertigation; Site specific management (SSM); Sensors - information gathering and application; Crop simulation models - role in precision farming; AI- based crop health monitoring with drones in agriculture.

UNIT V	PRECISION FARMING OF CROPS	9

Precision farming technology – Cotton, Sugar cane, Banana, Grapes, Turmeric, Onion, Chilli, Brinjal, Bitter gourd, Bottle gourd, Cauliflower, Cabbage, Marigold, Jasmine and Tuberose.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer basic concepts in different types of protected cultivation system.	Understanding (K2)
CO2	illustrate the best practices to be followed for higher yield of vegetable crops.	Analyzing (K4)
CO3	identify advanced technology of flowers production in protected cultivation.	Understanding (K2)
CO4	analyze precision farming techniques and their relevance in modern agriculture.	Analyzing (K4)
CO5	apply precision farming techniques in various crops.	Applying (K3)

TEXTBOOKS

1. Sanjeev kumar, S.N.Saravaiya and A.K.Pandey., "Precision farming and protected cultivation concepts and applications", CRC Press, 2021.
2. Dr. B. Ashok Kumar, Eggadi Ramesh, V. Sindhu., "Book of Protected Cultivation and Precision Farming for Horticultural Crops", 2021.

REFERENCES

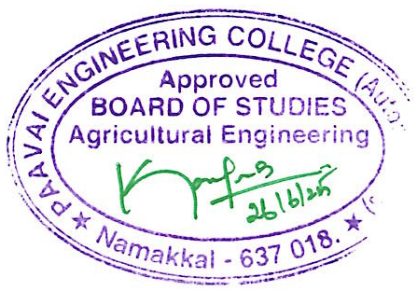
1. D. K. Singh., K. V. Peter., "Protected Cultivation of Horticultural Crops", New India Publishing Agency, 2014.
2. Singh, Brahma Dutt and Arora, A., "Precision Farming in Horticulture", Agrotech Publishing Academy, 2019.
3. Naved Sabir, Awani Kumar Singh, Murtaza Hasan., "Greenhouse Agriculture: Production and Protection", Pentimer Publications, 2021.
4. Suresh, R. Nirala, S. K., "Precision Farming Techniques for Protected Cultivation", PHI publisher, 2020.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes(PSO'S)

(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	2	1	2	-	2		-	-	-	1	3	2
CO2	2	-	-	1	2	1	1	-	-	-	-	2	3	3
CO3	2	-	-	1	2	1	1	-	-	-	-	2	3	3
CO4	3	2	3	2	3	2	2	-	-	-	-	1	2	3
CO5	3	-	-	2	2	1	1	-	-	-	-	2	3	2



AI23453	AGRICULTURAL ECONOMICS AND EXTENSION	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart the fundamental knowledge of economics law and cost concepts.
2	analyze the factor-product relationship to determine optimal resource use in crop production.
3	get an idea about farm planning and resource management strategies to develop effective farm budgets.
4	expose the different extension methods for communication to take the work from lab to field.
5	infer the concepts of extension teaching and various types of training to farmers.

UNIT I	LAWS OF ECONOMICS	9

Agricultural Economics- Definition and scope: Basic law of economics - Demand and Supply concepts, Law of increasing, Diminishing and constant returns, Equi-marginal returns; Scale of Economies-External and Internal economies and Diseconomies; Cost concepts – Types and Cost curves.

UNIT II	PRODUCT RELATIONSHIP	9

Factor-factor relationship and concepts - Principle of substitution, Isoquant, Isocline, Expansion path, Ridge line and least cost combination of inputs; Product-product relationship - Production possibility curve, Iso-revenue line and optimum combination of outputs; Estimation of cost of cultivation and production of crops - annual and perennial crops; Preparation of interview schedule and farm visit for data collection.

UNIT III	MANAGEMENT OF RESOURCES AND FARM MANAGEMENT	9

Risk and uncertainty – concept, causes for uncertainty, managerial decisions to reduce risks in production process; Management of resources - types of resources, land, labour, capital and measurement of their efficiencies, Mobilization of farm resources; Farm planning - Elements of farm planning, Farm level management system; Farm budgeting - whole farm budgeting and partial budgeting.

UNIT IV	EXTENSION CONCEPT AND COMMUNICATION	9

Extension - definition and meaning; Education - Types of Education - Difference between Formal and Extension Education; Function and scope of Extension - Principles of Extension, Steps in Extension Teaching; Communication - Basic functions of Communication, Models of Communication, Barriers of Communication.

UNIT V	EXTENSION TEACHING METHODS	9

Extension teaching methods- individual, group and mass contact methods - merits and demerits; Audio-Visual aids- Definition, Classification, Purpose, Planning and selection, Combination and use; Modern communication methods; Village kiosks; Kisan Call Centre (KCC); Capacity building of extension personnel and farmers – meaning, definition, types of training, training to farmers, farm women and rural youth; FTC - KVK.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the basic laws of economics, demand-supply concepts, and cost relationships relevant to agriculture.	Understanding (K2)
CO2	analyze factor-factor and product-product relationships to determine optimal resource and output combinations in crop production.	Analyzing (K4)
CO3	apply farm management principles and resource allocation strategies to develop effective farm plans and budgets.	Applying (K3)
CO4	understand the principles, functions, and models of agricultural extension and communication for effective rural knowledge transfer.	Understanding (K2)
CO5	apply various extension teaching methods and communication tools to enhance capacity building among farmers and extension personnel..	Applying (K3)

TEXTBOOKS

1. S. Subba reddy, Raghu Ram.p, Neelakanta Sastry.T.K and Bhavani Devi., "Agricultural Economics", Oxford- 2nd edition, 2019.
2. Dr. N. Sunanda., "Principles of Agricultural Economics", ARAU, 2022.

REFERENCES

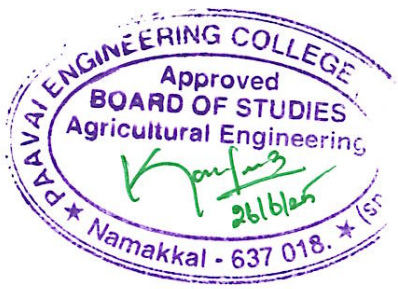
1. S.V. Supe., A Textbook of Extension Education, Agrotech Publishing Academy, 2015.
2. G.L.Ray., "Extension Communication and Management", Kalyani Publication, 2017.
3. Renu Arya, R.L.Arya, Anupriya Arya, Ram Ashish Yadav & Prashun Sachan., "Fundamentals of Agricultural Extension", Scientific Publisher, 2022.
4. NPTEL course-https://onlinecourses.swayam2.ac.in/nou25_hs28/preview.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes(PSO'S)

(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	1	-	-	-	1	-	-	-	1	3	2
CO2	2	3	2	1	-	-	-	-	-	-	-	1	2	3
CO3	2	2	2	1	1	2	-	-	-	-	-	2	2	3
CO4	1	-	1	2	-	3	1	2	2	2	-	1	2	3
CO5	1	-	1	2	3	3	1	2	2	3	-	1	2	3



AI23454	AGRICULTURAL STRUCTURE AND ENVIRONMENTAL CONTROL	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the physiological responses of livestock to environmental factors
2	impart basic knowledge of design and cost estimation of farm structures
3	enrich knowledge of water supply and its management
4	familiarize students with various sources of power supply.
5	understand the principles of designing sewage systems

UNIT I	PLANNING FARMSTEADS AND LIVESTOCK HOUSING	9

Planning and layout of farmstead; Physiological reactions of livestock- solar radiation and other environmental factors; Livestock production facilities- BIS, Standards for dairy, piggery, poultry and other farm structures.

UNIT II	DESIGN AND COST ESTIMATION OF FARM STRUCTURES	9

Design, construction and cost estimation of farm structures- Animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry; Design and construction of rural grain storage system- engineering for rural living and development, rural roads, cost, repair, maintenance.

UNIT III	WATER SUPPLY AND WASTE MANAGEMENT IN RURAL AREAS	9

Sources of water supply- Norms of water supply for human being and animals; drinking water standards and water treatment- suitable to rural community, Site and orientation of building in regard to sanitation, community sanitation system; sewage system its design, cost and maintenance, design of septic tank for small family.

UNIT IV	RURAL ENERGY MANAGEMENT AND ENVIRONMENTAL SUSTAINABILITY	9

Estimation of power requirement for domestic and irrigation, source of power supply, use of alternate source of energy; Electrification of rural housing- Scope, importance, need for environmental control; Renewable and non-renewable resources- Equitable use, concept of eco system, biodiversity of its conservation; Environmental pollution and their control; Solid waste management system.

UNIT V	RURAL WASTEWATER MANAGEMENT	9

Sewage system- design, cost and maintenance; design of septic tank for small family; Estimation of domestic power requirement, source of power supply and electrification of rural housing.

	TOTAL PERIODS:	45

COURSE OUTCOMES	At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	infer knowledge of environmental interactions to optimize housing conditions	Understanding (K2)
CO2	estimate construction and maintenance costs for farm structures	Understanding (K2)
CO3	execution Plan for Site Selection and water sources	Applying (K3)
CO4	estimate power requirements for domestic and irrigation purposes	Applying (K3)
CO5	assess domestic power requirements for typical rural households	Applying (K3)

TEXT BOOKS

1. Hellickson, M.L. and Walker, J.N . "Ventilation of Agricultural Structures", 2009.
2. P. H. Pandey "Principles and Practices of Agricultural Structures and Environmental Control" 2010.

REFERENCES

1. Bengtsson, L.P. "Farm Structures in tropical climates", food and agriculture organization.1986.
2. Whitaker. J.H., "Agricultural buildings and structures", National Food & Energy, 2005.
3. ALbright, L.D., "Environmental control for animals and plants", American Society of Agricultural and Biological Engineers. 2010,
4. By S.C. Panda., "Agricultural Structures and Environment Control". 1999.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	-	2	2	2	-	-	-	-	1	2	1
CO2	3	3	3	2	3	-	2	-	-	-	-	1	-	-
CO3	3	2	3	2	2	2	3	-	-	-	-	1	1	1
CO4	3	2	2	2	3	2	3	-	-	-	-	1	-	1
CO5	2	2	2	2	2	3	3	-	-	-	-	2	1	2

AI23455	SEED PRODUCTION TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the importance, scope, and role of quality seed production in agriculture.
2	learn the principles, systems, and techniques involved in certified seed production.
3	describe the components and methods of seed processing, treatment, and testing.
4	analyze the organization, planning, and management of seed production enterprises.
5	apply scientific knowledge in crop-specific seed production of crops.

UNIT I	**SEED CHARACTERS**	**9**

Seed: Definition, characteristics, differences from grain; Features of good quality seed; Importance in crop production; Floral biology: self- and cross-pollination; Seed dormancy and methods to break dormancy; Genetic improvement methods: selection, hybridization, mutation, polyploidy; Overview of Seed Act and major legislations- New seed policy and their importance

UNIT II	**SEED PRODUCTION AND CERTIFICATION**	**9**

Seed Multiplication-systems, classes of seed, multiplication ratio, field selection, planting ratio, isolation needs and rouging; Harvest and extraction of seed; Methods of hybrid seed production; Genetic deterioration during crop production cycles; Seed certification process Phases of seed certification, legal basis, prerequisites for applicability, description of the specific steps of the certification process.

UNIT III	**SEED PROCESSING AND TESTING**	**9**

Seed processing Principle, components; Processing plant Layout Types; Processing steps-preliminary cleaning, basic cleaning and grading, equipment used in each steps; Seed drying & treatment; Seed testing-sampling, methods, Types, procedures, specific tests conducted for different purposes (service, certification and seed law enforcement); Standards prescribed for different crops

UNIT IV	**POLICY PROGRAMMES FOR SEED QUALITY**	**9**

Types of seed organizations: public, private, cooperative, quasi- governmental; Structure and planning of seed enterprises; Marketing strategies, demand and supply analysis; Costing, pricing, packaging practices; Overview of seed export and import procedures; Seed/plant quarantine essentials

UNIT V	**SEED PRODUCTION IN SPECIFIC CROPS**	**9**

Seed production techniques for Cereal Crops- Rice, Maize; Pulse Crops- Black gram; Oilseed - Crops - Groundnut, Sunflower; Fiber Crops - Cotton; Vegetable Crops - Tomato, Brinjal and Onion.

	TOTAL PERIODS	**45**

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	acquire basic knowledge of seed production	Understanding (K2)
CO2	understand various methods of seed production	Understanding (K2)
CO3	apply principles of seed processing and testing for quality assurance	Applying (K3)
CO4	examine planning and management strategies in seed production programmes	Analyzing (K4)
CO5	practice the seed production techniques for important crops	Applying (K3)

TEXT BOOKS

1. Singh, S.P. (2021). "Commercial Vegetable Seed Production." Kalyani Publishers, Chennai..
2. Agarwal, R.L. (2024). "Seed Technology". Oxford & IBH Publishing Co., New Delhi.

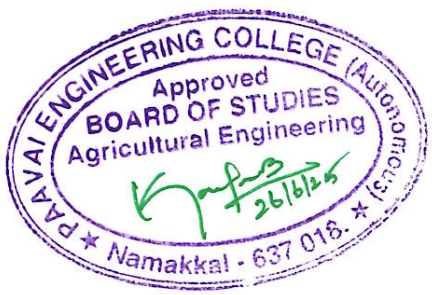
REFERENCES

1. Subir Sen & Ghosh, N. (2019). "Seed Science and Technology". Kalyani Publishers, Chennai.
2. Dahiya, B.S., & Rai, K.N. (1997). "Seed Technology". Kalyani Publishers, Chennai.
3. George, Raymond A.T. (2009). "Vegetable Seed Production". Longman Orient Press, London and New York.
4. ISTA (2018). "Handbook of Seedling Evaluation". International Seed Testing Association.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1	1	1	1	–	–	–	2	3	2
CO2	3	3	2	1	2	2	2	–	–	–	–	2	3	2
CO3	3	3	3	2	3	2	2	1	–	1	–	2	3	2
CO4	2	2	2	2	2	2	2	2	2	2	1	3	3	3
CO5	3	2	2	2	3	2	2	1	1	2	1	3	3	3



AI23456	CLIMATE CHANGE AND ADAPTATION	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand basics principles of atmosphere and components
2	identify the major ozone-depleting gases
3	enrich knowledge about the impact of climate change on agriculture
4	understand water resource management under climate stress.
5	expose the Future Clean Technologies

UNIT I	ATMOSPHERE AND ITS COMPONENTS	9

Atmosphere- Layer, Importance, Physical, Chemical Characteristics of atmosphere, Vertical structure of the atmosphere, Composition of the atmosphere; Atmospheric stability; Temperature profile of the atmosphere - Temperature inversion, Lapse rates; effects of inversion on pollution dispersion.

UNIT II	EARTH'S CLIMATE SYSTEM	9

Role of ozone in environment - ozone layer, ozone depleting gases; Green House Effect- Radiative effects of Greenhouse Gases, greenhouse gases emission, mitigation; Global Warming - Definition , Causes , Impacts, Role of Individuals.

UNIT III	IMPACT OF CLIMATE CHANGE	9

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, Society; Methods and Scenarios; Projected Impacts for Different Regions; Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes; Anthropogenic activity- Definition, Scope, Anthropocene concept.

UNIT IV	MODELING AND PREDICTING CLIMATE CHANGE	9

observation – analysis, forecast, predictions, projections; Evidence of observed climate change – temperature, global warming, greenhouse gases; Future projections - Global climate models, Regional climate models; projections for world and India - uncertainties in projection; IPCC - working groups role, assessment reports released; UNFCC – role, initiatives; AI in Water Resource Management under Climate Stress.

UNIT V	POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE	9

Clean Development Mechanism –Carbon Trading; future Clean Technology – Biodiesel, Natural Compost, Eco-Friendly Plastic; Alternate Energy – Hydrogen, Bio-fuels, Solar Energy, Wind, Hydroelectric Power; Energy Supply – Transport, Buildings, Industry, Agriculture, Forestry ; Carbon sequestration – Carbon capture and storage (CCS) ,Waste (MSW & Bio waste).

	TOTAL PERIODS:	45

COURSE OUTCOMESS		BT MAPPED
At the end of this course, the students will be able to		(Highest Level)
CO1	identify layers, composition, and characteristics of the atmosphere.	Understanding (K2)
CO2	assess the impacts of global warming on ecosystems and human societies	Understanding (K2)
CO3	estimate different methods and projections of climate change impacts.	Applying (K3)
CO4	evaluate global and regional climate models and discuss their projections for future climate scenarios.	Applying (K3)
CO5	analyze the role of alternate energy sources and carbon sequestration techniques	Analysing (K4)

TEXT BOOKS

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.
2. Andreas Schmittner "Introduction to Climate Science", open Textbook Library 2012.

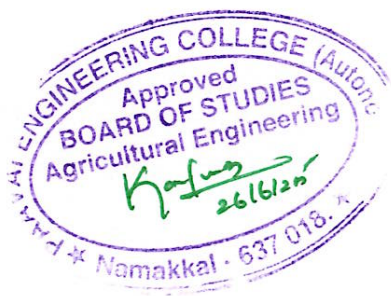
REFERENCES

1. Robert T. Watson, Marufu C. Zinyowera, and Richard H. Moss, "Adaptation and mitigation of climate change-Scientific Technical Analysis" , Cambridge University Press, Cambridge, 1995.
2. J.M. Wallace and P.V. Hobbs, "atmospheric science", Elsevier , academic Press, 2006.
3. Jan C. van Dam, "Impacts of Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.
4. Robert U. Onyeneke "Energy Transition Climate Action and Sustainable Agriculture" , federal university, 2000.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	-	1	2	3	-	-	-	-	2	1	1
CO2	2	-	-	-	1	1	2	-	-	-	-	1	1	1
CO3	3	3	2	3	1	3	3	-	-	-	-	3	-	-
CO4	3	3	2	3	2	3	2	-	-	-	-	3	1	-
CO5	3	3	3	2	3	3	3	-	-	-	-	2	-	1



AI23457	SYSTEM ANALYSIS IN AGRICULTURAL ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	introduce fundamental concepts of systems and operations research relevant to agricultural engineering.
2	develop skills to formulate and solve linear programming problems optimizing agricultural resources.
3	apply transportation and assignment models for efficient distribution in agriculture.
4	analyze queuing systems and network analysis to improve agricultural production and supply chain management.
5	explore decision-making tools like game theory and simulation tailored to agricultural problems.

UNIT I	SYSTEMS AND LINEAR PROGRAMMING IN AGRICULTURE	9

System concepts and agricultural systems overview - Introduction to Operations Research (OR) in agriculture - Formulation of Linear Programming Problems (LPP) with agricultural examples -Graphical solution method for two-variable LPP- Simplex method for solving LPP - Concept of duality and agricultural interpretation - Special cases in LPP (unbounded, infeasible, multiple solutions) -Shadow prices and their significance in agricultural resource allocation.

UNIT II	TRANSPORTATION AND ASSIGNMENT MODELS IN AGRICULTURAL LOGISTICS	9

Transportation model formulation for agricultural goods distribution - Methods for initial basic feasible solution: North West Corner rule, Least Cost method, Vogel's Approximation method - Optimality test: MODI method - Simple transportation problems with agricultural data - Assignment problem: Hungarian method - Applications in farm equipment allocation and labor assignment.

UNIT III	QUEUING THEORY AND AGRICULTURAL SERVICE SYSTEMS	9

Elements and characteristics of queuing systems -Single channel single server system - Single channel multi-server system -Applications to agricultural services such as irrigation, harvesting, storage.

UNIT IV	NETWORK ANALYSIS AND PROJECT MANAGEMENT IN AGRICULTURE	9

Rules for constructing networks (nodes, events, activities) - Time estimates: optimistic, pessimistic, most likely (PERT) - Critical Path Method (CPM) and Program Evaluation Review Technique (PERT) - Resource leveling and smoothing techniques - Merits and demerits of CPM and PERT - Decision trees for agricultural investment decisions - Minimax and Maximax criteria for agricultural risk analysis.

UNIT V	DECISION MAKING TOOLS IN AGRICULTURAL ENGINEERING	9

Introduction to Game Theory and applications in agriculture - Concepts: saddle point, algebraic, arithmetic, graphical, and LPP methods - Applications: crop choice, pest control, marketing strategies - Simulation techniques: Monte Carlo simulation for crop yield and weather impact prediction - Case studies on agricultural system simulation.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	explain key concepts of systems and operations research in agricultural engineering.	Understanding (K2)
CO2	formulate and solve linear programming problems for agricultural optimization.	Understanding (K2)
CO3	apply transportation and assignment models to agricultural logistics challenges.	Applying (K3)
CO4	analyze queuing systems and implement CPM & PERT for agricultural project management.	Analyzing (K4)
CO5	explain game theory and simulation techniques for strategic decision-making in agriculture.	Analyzing (K4)

TEXTBOOKS

1. Srinivasan.G (2010) " Operations Research; Principles and Applications", ISBN-978-81-203-4208-8
2. K. Vohnout (2003) " Mathematical Modeling for System Analysis in Agricultural Research".
3. Henry L. Langhaar (1951) –" Dimensional Analysis and Theory of Models" John Wiley & Sons, Inc.

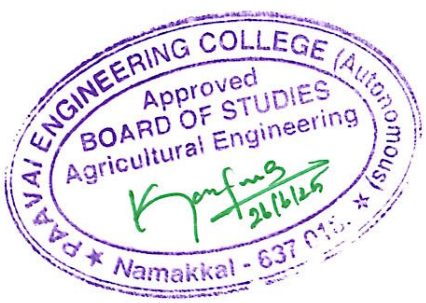
REFERENCES

1. Kapoor, V.K. (1994). "Operations Research". Sultan chand & sons, New Delhi.
2. Dharani. S and Venkata Krishnan. (1990). "Operations Research Principles & Problems". Keerthi Publishing homes Pvt. Ltd.
3. Gupta, P.K. and Man Mohan. (1994). "Problems in Operations Research". Sultan chand & sons, New Delhi.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	3	1	1	-	-	1	2	-	3	-	1	-
CO2	2	2	2	-	1	-	-	-	-	-	-	-	2	-
CO3	1	2	2	3	2	2	3	1	3	2	3	2	1	-
CO4	1	2	2	1	-	-	1	2	3	2	2	1	1	1
CO5	1	2	1	1	2	1	1	2	2	2	2	1	2	1



AI23551	ERGONOMICS AND SAFETY IN AGRICULTURAL ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	study about ergonomics principles
2	impart knowledge on various physical work load in farm operations.
3	acquire knowledge on energy requirement in farm operations.
4	get an idea about anthropometry principles.
5	know about equipment/work place design, safety in farm operations

UNIT I **ERGONOMICS** **9**

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; ISO 50001.

UNIT II **PHYSIOLOGICAL FUNCTIONS** **9**

Human Skeletal system- muscle, structure and function; Physiological stress, Efficiency of work, Physical functions, Age and individual differences in physical functions, Physiological and operational criteria of physical activity.

UNIT III **ENERGY EXPENDITURE** **9**

Personal Protection; 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 IV **ANTHROPOMETRY** **9**

Anthropometry, introduction- Types of data, Principles of applied anthropometry - 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 V **HUMAN ENGINEERING IN TRACTOR DESIGN** **9**

The operator-Machine Interface; Operator exposure to environmental factors-Thermal comport for tractor operator; Spatial, Visual and Control.

TOTAL PERIODS: 45

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	summarize the various principles of ergonomics.	Understanding (K2)
CO2	make use of physical activities related to farm operations.	Applying (K3)
CO3	understand the energy requirements in farm operations.	Applying (K3)
CO4	acquire knowledge on cost benefit analysis.	Applying (K3)
CO5	examine to improve the performance of the farm systems	Analyzing (K4)

TEXT BOOKS

1. Bridger, R.S. "Introduction to ergonomics", McGraw Hill, INC, New York. 1995.
2. "Hand Book of Agricultural Engineering", Indian Council of Agricultural Research, New Delhi. 2013. (ISBN : 978-81-7164-134-5)

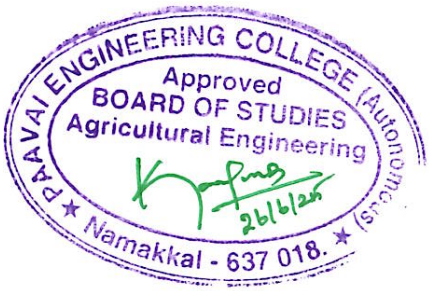
REFERENCES

1. Wesley E.Woodson. "Human Factors design Hand Book". McGraw Hill Book Co. New York. 1981.
2. Sharma, D.N and Mukesh, S. "Design of Agricultural Tractor- Principles and Problems", Jain Brothers, New Delhi. 2012.
3. Obome, David.J. "Engineering Work". John Wiley and Sons Ltd., 1982.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	1	2	-	-	-	1	-	2	-
CO2	2	-	2	2	-	3	2	-	-	-	2	2	2	-
CO3	-	-	1	2	-	3	2	-	-	-	-	-	1	-
CO4	2	2	3	2	1	-	-	-	-	-	-	-	2	-
CO5	1	3	3	2	3	1	-	2	-	-	2	-	1	-



AI23552	ENERGY CONSERVATION IN FOOD PROCESSING INDUSTRY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	learn the different aspects of energy auditing in the Food Industry.
2	understand the energy saving opportunity
3	know about the energy saving opportunities in existing food processing facilities
4	understand the facility in food processing industry.
5	gain knowledge in the field of waste recovery.

UNIT I	ENERGY MANAGEMENT	9

Define Energy Management- the need for Energy Management; Energy management techniques, the importance of Energy Management, managing Energy consumption; Energy Audit and types- Energy Audit Instruments, understanding Energy costs, benchmarking, Energy performance, matching energy use to requirements optimizing the input, fuel and energy substitution, material and Energy balance diagrams; Energy pricing- Energy and Environment and Energy Security.

UNIT II	ENERGY CONSERVATION IN AGRO-BASED INDUSTRY	9

Energy Conservation in the Indian industrial sector; Energy saving potential in the industry- boiler, furnaces, air compressors, refrigeration systems, heat exchangers, heat pumps, turbines, electric drives, pumps, cooling towers, fans and blowers; Energy Conservation in agriculture sector- Energy Conservation opportunities in pumps used in agriculture sector; summary.

UNIT III	ENERGY-SAVING OPPORTUNITIES IN EXISTING FOOD PROCESSING	9

Facilities Energy Consumption pattern- Energy Conservation in Grains and Oilseeds Milling Facilities, Sugar and Confectionary Processing Facilities, Fruit and Vegetable Processing Facilities, Dairy Processing Facilities, Meat Processing Facilities, Bakery Processing Facilities.

UNIT IV	FOOD PROCESSING WASTES AND UTILIZATION	9

Concepts of Anaerobic Digestion of Food Processing Wastes; Fermentation of Food Processing Wastes into Transportation Alcohols; Bio-diesel Production from Waste Oils and Fats; Thermo chemical Conversion of Food Processing Wastes for Energy Utilization.

UNIT V	WASTE HEAT RECOVERY	9

Waste Heat Recovery and Thermal Energy Storage in Food Processing Facilities; Sources waste heat in industries, Techniques: Novel Thermodynamic Cycles Applied to the Food Industry for Improved Energy Efficiency; Challenges and Limitations; Standard and Government policies.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	classify the energy resources based on sources and purposes	Understanding(K2)
CO2	Identify and recommend energy-saving techniques in electrical systems such as electric drives, pumps, fans, and blowers.	Applying (K3)

CO3	develop the energy efficient machinery systems and the technologies and methods for conservation of energy resources	Applying (K3)
CO4	categorize the types of energy audits in production agriculture for rural living and scope of energy conservation	Analyzing (K4)
CO5	make use of a case study on energy audit in agricultural fields for comparative studies	Applying (K3)

TEXTBOOKS

1. Umesh Rathore, "energy management", Kataria publications, 2nd ediiton, 2014.
2. L.Wang, "Energy Efficiency and Management in Food Processing Facilities", CRC Press, 2009.

REFERENCES

1. G Harihara Iyer, "Green Building Fundamentals", Notion press.com, 2022.
2. Guidebooks for National Certification Examination for "Energy Manager/Energy Auditors" Book-1, General Aspects.
3. B. Mattsson, and U. Sonesson, "Environmentally Friendly Food Processing", CRC Press, 2003.

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	2	1	-	-	-	2	1	-	-	1	1	2	-
CO2	-	-	-	-	-	-	3	1	-	-	3	1	1	-
CO3	1	2	3	-	-	1	3	-	-	-	-	-	1	-
CO4	-	2	2	3	-	-	3	-	-	-	-	-	1	1
CO5	3	2	-	-	-	2	2	-	-	-	2	2	1	1

AI23553	PRINCIPLES OF HEAT AND MASS TRANSFER	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	acquire knowledge on the concept of conduction mode of heat transfer.
2	classify different modes of convection
3	apply the stefan–boltzmann law and planck's law
4	explore the mechanisms of phase change processes
5	predict the mass transfer behavior

UNIT I	CONDUCTION	9

Basic concepts - Mechanism of heat transfer ,conduction, convection and radiation, fourier law of heat conduction; General differential equation of heat conduction - One dimensional steady state heat conduction- Cartesian and cylindrical coordinates, conduction through plane wall, Cylinders, Composite systems; Conduction with internal heat generation; Extended surfaces.

UNIT II	CONVECTION	9

Basic concepts – Convective heat transfer coefficients –Boundary layer concept; Types of convection – Forced convection –dimensional analysis, flow over plates, cylinders and spheres– laminar and turbulent flow; Free convection - Dimensional analysis – flow over vertical plates, horizontal plate, inclined plate, cylinders and spheres, external flow, internal flow.

UNIT III	RADIATION	9

Basic concepts, law of radiation – Stefan Boltsmann law, kirchoff's law , black body radiation ,Gray body radiation; Heat exchange between two gray surfaces-Shape factor algebra, electrical analogy, radiation shields, introduction to gas radiation.

UNIT IV	PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS	9

Nusselts theory of condensation – Pool boiling, flow boiling, correlations in boiling; Types of heat exchangers – Heat exchanger analysis, LMTD method and NTU Effectiveness, overall heat transfer coefficient, fouling Factors.

UNIT V	MASS TRANSFER	9

Diffusion mass transfer-Fick's Law of diffusion, Steady state molecular diffusion; Convective mass transfer – Momentum, heat and mass transfer analogy, convective mass transfer correlations.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	discuss steady state heat conduction problems for composite systems and fins.	Understanding (K2)
CO2	determine convective heat transfer coefficients.	Applying (K3)
CO3	describe various laws of radiation and concepts of shape factor algebra	Applying (K3)

CO4	discuss phase change in heat transfer and solve problems on heat exchangers.	Applying (K3)
CO5	explain mass transfer laws and solve problems in mass transfer.	Analyzing (K4)

TEXT BOOKS

1. Rajput R. K., "Heat and Mass Transfer" S Chand and Co Ltd, 2008
2. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2004.

REFERENCES

1. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 2012.
2. Yunus A. Cengel and Afshin Jahanshahi Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", Mcgraw-Hill Education., 2017.
3. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 2001.
4. Nag P.K, "Heat Transfer", T.M. McGraw-Hill, New Delhi, 2002.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	2	2	1	-	-	-	-	-	3	2
CO2	3	3	2	2	2	2	1	-	-	-	-	-	3	2
CO3	3	3	2	2	2	2	1	-	-	-	-	-	3	2
CO4	3	3	2	2	2	2	1	-	-	-	-	-	3	2
CO5	3	3	2	2	2	2	1	-	-	-	-	-	3	2

AI23554	BIO ENERGY RESOURCE TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	introduce the fundamentals of biomass types, conversion technologies, and biogas production systems.
2	provide knowledge on slurry management, bioenergetics, and bioresource utilization.
3	gain expertise in alcohol and biofuel production techniques, including thermochemical conversions.
4	explain the working principles of bioreactors, fermentors, and wastewater treatment methods.
5	develop energy plantation techniques, biomass utilization, and their environmental impacts.

UNIT I **INTRODUCTION TO BIO RESOURCE** **9**

Definition and origin of bioresources -Types of biomass and their characteristics, biomass conversion technology; Biodegradation - steps involved in biogas production- parameters affecting gas production; Types of biogas plants- Construction details, operation and maintenance; Biopolymers - Application in agricultural uses as mulch films, seed coatings, Biodegradable packaging materials.

UNIT II **BIOENERGY CONVERSION AND BIOPRODUCT FORMATION** **9**

Slurry handling techniques - enrichment and utilization, Biogas appliances, Biofuels and bioprocessing Technologies; Biochemical characteristics of bio resources- Bioenergetics principles, Biocatalysis mechanism, Kinetics of bio-based product formation.

UNIT III **BIOCHEMICAL AND THERMOCHEMICAL CONVERSION OF BIOMASS** **9**

Alcohol and ethanol production - Acid hydrolysis, enzyme hydrolysis, methanol synthesis; Antibiotics, Enzymes; Principles of thermochemical conversion - combustion, pyrolysis; Gasification - types of gasifiers.

UNIT IV **BIO REACTORS AND FERMENTORS** **9**

Bio reactors /fermentors- Batch type, Continuous stirred tank reactors; Biological waste water treatment- Activated sludge process, Downstream processing, Recovery and purification of products; Fermentation processes - general requirements, an overview of aerobic and anaerobic fermentation processes and their industrial application.

UNIT V **ENERGY AND ENVIRONMENT** **9**

Principles of operation - chemical reaction, cleaning and cooling; Utilization- Improved wood burning stove, Energy plantations, Biomass briquetting, co generation; Impact on Environment and Bioenergy policy.

TOTAL PERIODS: **45**

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	identify biomass types, conversion technologies, and biogas production systems.	Understanding (K2)
CO2	explain slurry handling, bioenergetics, and biocatalytic mechanisms in bioenergy.	Understanding (K2)
CO3	evaluate alcohol and biofuel production techniques including gasification methods.	Analyzing (K4)
CO4	analyze the functioning of bioreactors and fermentation systems in bio-processing	Analyzing (K4)
CO5	assess biomass energy systems, improved stoves, and their environmental implications	Applying (K3)

TEXT BOOKS

1. Rai G. D, "Non conventional sources of Energy", Khanna publishers, New Delhi, 2017.
2. Bouley James E & David Follis, "Biochemical Engineering Fundamentals", Mc Graw-Hillpublishing companyTokyo, 1986.

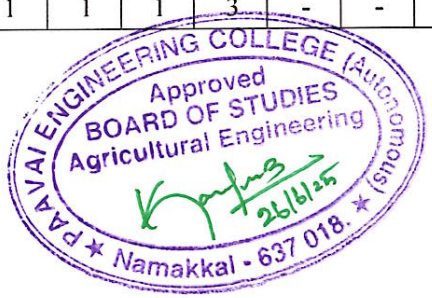
REFERENCES

1. Rajput. R.K. "Non- Conventional Energy Sources and Utilization", S. Chand & Company Pvt. Ltd,New Delhi, 2013.
2. Rao. S and B.B. Parulekar. "Energy Technology – Non conventional, Renewable and Conventional". Khanna Publishers, Delhi, 2000.
3. Chawla O.P, "Advances in Biogas Technology", ICAR publication New Delhi,1986.
4. British BioGen. 2007, "Anaerobic digestion of farm and food processing practices- Good practice guidelines", London.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	2	1	1	-	-	-	-	1	2	2
CO2	3	2	2	1	1	1	2	-	-	-	-	1	2	2
CO3	3	2	2	1	1	1	2	-	-	-	-	1	2	2
CO4	3	2	2	1	2	1	1	-	-	-	-	2	2	2
CO5	2	2	2	1	1	1	3	-	-	-	-	2	3	2



AI23555	ENERGY AUDITING AND ITS MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	classify various forms of energy and explain their role in modern society.
2	acquaint the students in energy auditing in industries.
3	comprehend the principles, types, and operational parameters of cogeneration systems.
4	infer knowledge regarding electrical load management and controlling maximum demand in industrial settings.
5	gain insights into building water pump systems, building management systems (BMS), and uninterruptible power supply (UPS).

UNIT I	ENERGY CONSERVATION CONCEPTS	9

Energy - classification - scenario; Energy pricing - factors affecting energy prices - energy market trend; Energy and environment; Energy conservation and its importance; Energy strategy for the future – energy conservation act and its importance.

UNIT II	ENERGY AUDITING AND ECONOMICS	9

Scope of energy audit - principles - energy audit strategy - types - detailed energy audit steps; Role of energy managers in industries; Energy performance - bench marking - fuel substitutions - energy audit instruments - material and energy balance - energy conversion - energy index - cost index ; Financial management - financing options.

UNIT III	THERMAL ENERGY AUDIT	9

Introduction to fuels - properties of liquid fuels- properties of coal, gaseous fuels and agro residues; Combustion- oil, coal ,gas and biomass; Cogeneration-need-principle-classification-factors of influencing cogeneration choice-important technical parameters- prime movers-typical cogeneration performance parameters-micro turbine.

UNIT IV	ELECTRICAL ENERGY AUDIT	9

Introduction to electric supply systems - electrical billing - electrical load management and maximum demand control-power factor improvement and benefits- transformers- distribution losses in industrial system-assessment of distribution &transmission losses in power systems- estimation of technical losses in distribution system- demand side management.

UNIT V	ENERGY CONSERVATION IN BUILDINGS	9

Energy conservation in buildings-Building definition as in energy conservation amendment-ECBC guidelines for building envelope, heating ventilation and AC systems, service hot water, lighting, electrical power; Building water pump system-building management system- uninterruptible power supply- star rating of buildings- energy efficiencies Measures in buildings.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	identify different energy types including their advantages and challenges.	Applying (K3)
CO2	compare between audit types and align them with specific audit goals	Analyzing (K4)
CO3	illustrate the concept of cogeneration and its relevance in energy conservation and efficiency	Understanding (K2)
CO4	apply methods to manage electrical loads and control maximum demand in an industrial setup.	Applying (K3)
CO5	categorize the role and components of a Building Management System (BMS) and UPS in energy efficiency.	Analyzing (K4)

TEXTBOOKS

1. "Guide books for National Certification Examination for Energy Managers and Energy Auditors", Book 1, 2, 3 Bureau Energy Efficiency, New Delhi. 2005
2. Murphy, W.R. and McKay, G "Energy Management" Butterworth & Co., Publishers Ltd., London. 1982.

REFERENCES

1. Craig B. Smith "Energy Management Principles, Applications, benefits & savings",Pergamon Press Inc. 1981.
2. Murgai, M.P. and Ram Chandra "Progress in Energy Auditing and Conservation- Boiler Operations", Wiley Eastern Ltd. 1990.
3. Victor B.Ottaviano, "Energy Management"An OTIS Publication. Ottaviano Technical Service Inc. 150. Broad Hollow Road, Melville, New York.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S)
(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	-	-	1	-	-	2	-	-	-	1	-	2	1
CO2	1	2	2	1	1	-	2	-	-	-	2	-	2	1
CO3	1	2	2	3	2	2	3	1	3	3	3	1	2	1
CO4	1	2	2	2	-	-	1	-	3	2	2	1	2	1
CO5	1	-	2	1	-	-	1	-	2	2	2	1	2	1

AI23556	CO-GENERATION AND WASTE HEAT RECOVERY SYSTEMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn about the various techniques of cogeneration and waste heat management
2	enhance the knowledge on various cogeneration technologies
3	identify the applications of cogeneration technologies
4	gain knowledge on waste heat recovery systems
5	learn about the various heat recovery technologies

UNIT I	INTRODUCTION	9

Principles of cogeneration-Performance indices of cogeneration systems; Cogeneration systems based on steam Turbine-gas turbine-combined cycle and IC engines.

UNIT II	COGENERATION TECHNOLOGIES	9

Combined cycles cogeneration systems; Advanced cogeneration systems based on fuel cells-Stirling Engines; Cogeneration plants electrical interconnection issues.

UNIT III	ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES	9

Applications of cogeneration in utility sector-industrial-construction and rural sectors; Impacts of cogeneration plants-fuel-electricity and environment.

UNIT IV	WASTE HEAT RECOVERY SYSTEMS	9

Waste heat sources-Selection criteria for waste heat recovery technologies; Recuperative and regenerative heat exchangers for waste heat recovery; Waste heat boilers-classification-design considerations-sizing-location; Performance calculations- service conditions; Heat pumps – types-design.

UNIT V	HEAT RECOVERY TECHNOLOGIES	9

Application- Economic analysis of cogeneration and waste heat recovery systems; procedure for optimization of system selection and design-load curves-sensitivity analysis; Regulatory and financial framework for cogeneration and waste heat recovery systems; Environmental considerations; Mitigation of harmful emissions from energy production-conversion and utilization technologies; Control of air- water and ground pollution.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	apply a suitable technology for waste heat management	Applying (K3)
CO2	gain the knowledge on cogeneration systems and its combined cycles	Understanding (K2)
CO3	knowledge on applications and impacts of cogeneration plants	Applying (K3)
CO4	select a proper heat recovery system to enhance the performance	Applying (K3)
CO5	make use of economic analysis of cogeneration and heat recovery	Applying (K3)

TEXT BOOKS

1. Khartchenko N.V. Green Power: "Eco-Friendly Energy Engineering", Tech Books, New Delhi, 2004
2. Boyce. M.P. "Cogeneration and Combined Cycle Power Plants", ASME press, 2nd ed., 2010

REFERENCE BOOKS

1. Pehnt M. et al. "Micro Cogeneration", Springer, 2005.
2. Meckler, M., Hyman L.B. "Sustainable on-Site CHP Systems", McGraw-Hill, 2010.
3. Obara S. "Distributed energy systems", Nova Science, 2009
4. Khartchenko N.V. "Advanced Energy Systems", Taylor and Francis, Washington DC, 1998.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	-	2	-	-	-	1	-	-	-	-	-	1	1
CO2	2	2	2	2	1	-	-	1	1	-	-	1	-	2
CO3	2	1	2	2	-	1	-	-	-	-	1	-	1	1
CO4	2	1	1	-	1	1	1	1	1	1	-	-	2	2
CO5	1	2	2	2	-	-	-	-	1	1	1	-	1	-

AI23557	AIR POLLUTION AND CONTROL ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	study the historical development and significance.
2	analyze the processes involved in weather formation.
3	understand maintenance, safety, and operational considerations.
4	examine the design and functioning of control equipment.
5	develop strategies for indoor air quality improvement.

UNIT I	INTRODUCTION TO AIR POLLUTION	9

Structure and composition of Atmosphere; Definition- Scope and Scales of Air Pollution – Sources and classification of air pollutants- their effect on human health, vegetation, animals, property, aesthetic value and visibility ; Ambient Air Quality and Emission standards – Ambient and stack sampling and analysis of Particulate and Gaseous Pollutants.

UNIT II	METEOROLOGY	9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT III	CONTROL OF PARTICULATE CONTAMINANTS	9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT IV	CONTROL OF GASEOUS CONTAMINANTS	9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations.

UNIT V	INDOOR AIR QUALITY MANAGEMENT	9

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries; Sources and Effects of Noise pollution; Measurement Standards –Control and Preventive measures.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	define air pollution and classify different types of air pollutants.	Understanding (K2)
CO2	apply meteorological knowledge to real-world applications.	Applying (K3)
CO3	explain the principles governing the behavior and removal of particulate matter.	Analyzing (K4)
CO4	identify the major types and sources of gaseous air pollutants.	Understanding (K2)
CO5	analyze appropriate methods and instruments to monitor indoor air quality.	Analyzing (K4)

TEXT BOOKS

1. V.Sankarasubmaniyan, Dr.K.Elangovan. Dr.A.Prabaghar, "Air pollution and control Engineering" Lakshmi Publication, Chennai, 2020.
2. S.Ganesaguru., "Air Pollution and control engineering" ARS Publication Primate limited,2020.

REFERENCES

1. De Nevers, N., "Air Pollution Control Engineering", McGraw Hill, New Delhi, 1995
2. Rao M. N., "Air Pollution", Tata McGraw Hill Publication.2020
3. Wark Kenneth and Warner C.F, "Air pollution its origin and control". Harper and Row Publishers, New York, 1997.
4. Dr. Keshav kant and Er.Rajni kant. "Air Pollution and Control" Khanna Publishing House.2019.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	-	1	-	1	1	3	1	-	-	-	-	1	1
CO2	2	-	2	-	1	3	2	1	-	-	-	-	2	-
CO3	1	-	1	-	2	2	2	2	-	-	-	-	1	-
CO4	1	-	1	-	1	1	2	1	-	-	-	-	1	1
CO5	1	-	1	-	1	1	2	1	-	-	-	-	1	1

AI23651	DISASTER MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand disaster types, causes, and impacts.
2	promote awareness of disaster risk reduction
3	understand how disasters and development affect community safety and progress.
4	impart knowledge over the disaster risk management.
5	apply disaster management concepts through real-life case studies and field work

UNIT I	INTRODUCTION TO DISASTER	9

Definition - Disaster,Hazard,Vulnerability,Resilience,Risks ; Disasters – Types of Disaster, Earthquake, Landslide, Flood ,Drought ,Fire Etc., Classification, Causes ; Impacts including Social,economic,political ,environmental, health ,psychological Etc., Differential impacts in terms of caste , class , gender , age , location , disability ; Global trends in disaster ; urban disaster ; pandemics ; climate change ; complex emergencies ; Dos and Don'ts during various types of Disasters.

UNIT II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9

Disaster cycle - Phases , Culture of safety - prevention - mitigation and preparedness community based DRR; Structural and Non-structural measures ; Roles and responsibilities of community – Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs) of States ,Centre and other stake-holders ; Institutional Processes and Framework at State and Central Level ; State Disaster Management-Authority (SDMA) ; Early Warning System – Advisories from Appropriate Agencies.

UNIT III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9

Factors affecting Vulnerabilities ; Differential impacts - Impact of Development projects such as dams - Embankments ; changes in Land-use; Climate Change Adaptation ; IPCC Scenario and Scenarios in the context of India ; Relevance of indigenous knowledge ; Technology used in disaster management ; local resources

UNIT IV	DISASTER RISK MANAGEMENT IN INDIA	9

Hazard and Vulnerability profile of India ; Components of Disaster Relief - Water , Food , Sanitation , Shelter, Health, Waste Management ; Institutional arrangements ; Disaster Management Act and Policy - Other related policies , plans , programs and legislation ; Role of GIS and Information Technology Components in Preparedness, Risk Assessment Response and Recovery Phases of Disaster; Disaster Damage Assessment.

UNIT V	APPLICATIONS, CASE STUDIES AND FIELD WORKS	9

Landslide Hazard Zonation-Case Studies ; Earthquake Vulnerability -Assessment of Buildings and Infrastructure, Case Studies ; Drought Assessment - Case studies ; Coastal Flooding -Storm Surge Assessment , Floods ,Fluvial and Pluvial flooding ; Forest Fires - Case Studies ; Man Made disasters - Case Studies ; Space Based Inputs for Disaster Mitigation and Management - field works related to disaster management- Application of AI in disaster management.

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	identify types and causes of disasters, analyze their impacts.	Analyzing (K4)
CO2	acquire Knowledge of various methods of risk reduction measures as well as mitigation.	Understanding (K2)
CO3	analyze the importance of planning development with disaster safety in mind.	Analyzing (K4)
CO4	learn how disasters are managed in India through laws, plans, and community efforts.	Understanding (K2)
CO5	apply disaster risk reduction strategies in practical situations.	Applying (K3)

TEXT BOOKS

1. R.Subramanian., "Disaster Management" , S Chand and company Ltd, 2022.
2. A.K.Srivastava., "Text Book of Disaster Management" Scientific Publishers, India, 2021.

REFERENCES

1. Shaikh Ubaid., "Disaster Management", Technical Publication private limited. 2018.
2. Dr. Rabi Narayana Misra., N.Misra.R "Disaster Management", Discovery Publishing House, 2017.
3. S.C.Sharma., "Disaster Management" Khanna Book Publishing, 2025.
4. Anthony Masys., "Disaster Management: Enabling Resilience" Springer International Publishing, 2014.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	-	-	1	-	2	-	-	1	-	-	1	1
CO2	3	2	-	-	2	-	2	-	-	1	-	-	1	1
CO3	2	2	-	-	2	-	2	-	-	1	-	-	2	1
CO4	1	3	-	-	1	-	2	-	-	2	-	-	2	1
CO5	1	1	-	-	1	-	2	-	-	1	-	-	2	1

AI23652	LANDSCAPE DESIGN AND SITE PLANNING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the fundamentals of landscaping design
2	analyse site conditions and seed sowing methods
3	apply principles of plant selection, planting methods, and irrigation techniques.
4	design landscape features for residential gardens, terrace gardens.
5	evaluate different surface treatments and develop layout plans for pathways, roads, and parking

UNIT I	FUNDAMENTALS OF LANDSCAPING	9

Landscape – definition, objectives, scope and benefits; Site survey – analysis, appraisal; Living components- Trees, shrubs, herbs, hedges; Non- living components- Fountain, statue, bird bath, garden seats; Landform design and grading.

UNIT II	SITE SELECTION AND PLANTING PRINCIPLES	9

Soil and Site Conditions – types of soil; Plant selection techniques – bare rooted, balled, containerize; Selection of trees and shrubs; Native Species; Seeding – sowing, planting methods; Planting Season.

UNIT III	PLANTING PRACTICES	9

Planting design - principles and practice of mulching - Pruning of trees and shrubs; Tools and implements used in landscape garden. Irrigation- Sprinkler irrigation, drip irrigation, surface irrigation; Fountains – working principle, components, uses; Drainage - design of surface drainage.

UNIT IV	LANDSCAPE APPLICATIONS	9

Landscape application in gardens - Terrace gardening- planting sapling ; layout of lawn on a terrace- construction of roof; Landscaping of residential areas – aesthetic elements; Lighting of gardens – techniques of lighting; Rockery with a waterfall-elements, uses; Landscape application in gardens - Shade Gardening, Rock Garden, Roof garden.

UNIT V	SURFACE TREATMENTS IN LANDSCAPING	9

Surface treatments - Landscape elements of construction - Path ways ; design and layout of Roads - earthen roads, concrete road ,Tar road; Layout of different styles of garden Parking requirements; Maintenance of landscape.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer the basic concept of landscape design	Understanding (K2)
CO2	select the suitable site and plants for designing landscape	Understanding (K2)
CO3	evaluate different irrigation methods and suitability for landscape applications.	Understanding (K2)
CO4	design the landscape for different type of gardening	Applying (K3)
CO5	design and layout the landscape parking and different roads	Analysing (K4)

TEXT BOOKS

1. Rita Bhuchnam, " Taylor's Master Guide to Landscaping", Houghton Mifflin Gardening, 2000.
2. Jack E Ingels, " Landscaping design" , Thomson Delmar Learning , 2021.

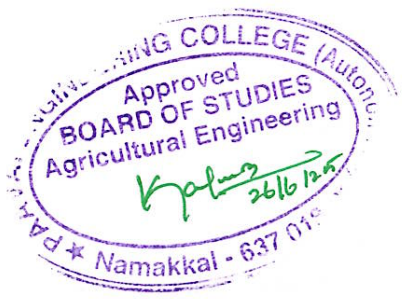
REFERENCES

1. Steven Angleyet, "Landscape Estimating and Contract Administration", Thomson Delmar Learning, 2001.
2. Jack E. Ingels & Alissa F. Smith "Landscaping Principles and Practices", Cengage, 2019.
3. Stephen W. Smith "Landscape Irrigation Design and Management", wiley 1996.
4. Nina Koziol, "Guide to Ponds, Fountains, Rain Gardens and Water Features" Creative Homeowner, 2023.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	1	1	-	2	-	-	-	-	1	1	1
CO2	2	3	2	2	1	-	3	-	-	-	-	2	1	1
CO3	2	2	3	2	2	-	3	-	-	-	-	1	1	1
CO4	2	2	3	2	2	-	3	-	-	-	-	1	1	1
CO5	2	2	2	2	2	-	2	-	-	-	-	1	1	1



AI23653	INDUSTRIAL AGRO FORESTRY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the role of forest resources and wood based supporting the industrial sector
2	study the establishment and economics of industrial wood plantations across various regions in India.
3	explore the marketing systems, and corporate involvement in the industrial agroforestry sector.
4	evaluate the environmental and socioeconomic impacts of industrial agroforestry.
5	analyze various wood-based industries, raw material sourcing, value addition technologies, and the overall economic assessment of industrial wood utilization.

UNIT I	FOREST RESOURCES AND WOOD-BASED INDUSTRIES	9

Role of forests in industrial sector, industrial raw material, demand and supply, indigenous and exotic industrial resources, extent of area, policy and legal issues towards industrial wood plantation; Major wood based industries in India-timber, pulp wood, plywood, matches, etc; Raw material requirements and their procurements.

UNIT II	INDUSTRIAL WOOD PLANTATIONS AND MANAGEMENT	9

Industrial wood plantations – status in India and different states, preferred species – current plantation management and establishment-propagation and plantation technique- economics of industrial agroforestry;pest and disease management for major industrial wood species, harvesting, reduced impact logging, mechanization.

UNIT III	SUPPLY CHAIN AND MARKETING IN AGROFORESTRY	9

Supply chain; definition, concept, supply chain network, logistic activities, Marketing system; marketing type and channel, price patterns of various industrial wood agroforestry plantations. Contract farming: concept and methods, contract tree farming system in India. Industrial experiences– price support system – constraints. Corporates in industrial agroforestry: International and National corporate, success stories. Corporate social responsibilities. Tree insurance.

UNIT IV	ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS OF AGROFORESTRY	9

Impacts of industrial agroforestry – ecological impacts; climatic, edaphic and biotic– carbon sequestration; Carbon storage potential of industrial agroforestry and carbon trading mechanism of industrial agroforestry, socioeconomic impacts–clean development mechanism; Certification of industrial plantations

UNIT V	INDUSTRIAL WOOD UTILIZATION AND VALUE ADDITION	9

Study of various wood-based industries; Raw material requirements and sourcing for plywood, pulp and paper, matchwood, and timber processing; Biomass power generation industries; Value addition technologies for wood products - Economics and impact assessment of industrial wood plantations.

	TOTALPERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	classify the significance of forest resources in industrial development.	Understanding (K2)
CO2	demonstrate knowledge of species selection and economic aspects of industrial wood plantations.	Understanding (K2)
CO3	identify supply contract farming systems, and the role of corporate, CSR initiatives in agroforestry.	Applying (K3)
CO4	simplify the ecological and socioeconomic benefits of industrial agroforestry.	Analyzing (K4)
CO5	analyze raw material sourcing strategies, biomass energy applications, value addition technologies, and conduct impact assessments of wood-based industries.	Analyzing (K4)

TEXTBOOKS

1. P.K. Ramachandran Nair, 1993, " An Introduction to Agroforestry",
2. Parthiban KT, Umarani R, UmeshKanna S, Sekar I, Rajendran P and Durairasu P. 2014 "Industrial Agroforestry: Perspectives and Prospectives" Scientific Publishers..

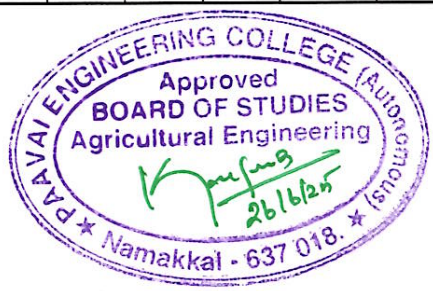
REFERENCES

1. "General aspects of energy management and energy audit", "Guide book for National certification for Engineers and Managers and Auditors", Bureau of energy efficiency.
2. Mehta T. 1981 "A Hand Book of Forest Utilization" International Book Distributors, Dehradun.
3. Nair PKR. 1993 "An Introduction to Agroforestry" Kluwer Academic publishers.

CO-POMAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S)
(1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	2	-	2	-	1	3	1	2	-	3	-	2	-
CO2	-	2	1	-	-	1	3	1	-	-	-	-	2	-
CO3	-	2	2	2	-	1	3	1	-	1	-	-	2	-
CO4	-	2	2	-	-	1	3	1	-	1	-	-	2	-
CO5	-	2	1	-	-	1	3	1	-	1	-	-	2	-



AI23654	FLOOD AND CONTROL MEASURES	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the fundamental characteristics of flood and flood plains
2	apply flood frequency analysis techniques
3	develop a holistic view of flood risk management
4	evaluate embankment performance
5	learn techniques for flood hazard assessment

UNIT I	CHARACTERISTICS OF FLOODS AND FLOOD PLAINS	9

Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, characteristics of flood flow, hydro-meteorological extremes, flood plain and its characteristics, anthropogenic influence on flood generation, analysis of impact of floods on society, ecological role of floods.

UNIT II	FLOOD ESTIMATION AND FORECASTING	9

Flood estimation - methods of estimation ; Estimation of flood peak - rational method, empirical methods, unit hydrograph method ; Statistics in hydrology ; Flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution; depth-area-duration analysis ; Flood forecasting - Flood routing - channel routing, Muskingum method, reservoir routing, modified Pulse method.

UNIT III	FLOOD MITIGATION AND STRUCTURAL MEASURES	9

Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs – levees - channel improvement ; Gully erosion and its control structures – design and implementation , Ravine control measures ; River training works; Planning of flood control projects and their economics.

UNIT IV	EARTHERN EMBANKMENTS	9

Earthen embankments functions, classification, foundation requirements, seepage through dams, flow net and its properties, seepage pressure, drainage, design and construction of earthen dam, stability of earthen embankments against failure by tension, stability of Subsurface dams - site selection and constructional features, check dam, small earthen embankments.

UNIT V	FLOOD HAZARD ANALYSIS AND MAPPING	9

Overview of hydrologic-Hydraulic models for flood estimation, calibration, validation, types of flood hazard maps ; Role of GIS and remote sensing in flood hazard mapping - contents in a flood hazard maps, format of the published map, reports, presentation of flood maps, updating and maintaining flood hazard maps, deducing risk from flood hazard maps ;

	TOTAL PERIODS	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe the physical and hydrological features of floodplains.	Understanding (K2)
CO2	apply the various methods for flood estimation and flood forecasting.	Applying (K3)
CO3	differentiate between structural and flood mitigation measures	Analyzing (K4)
CO4	explain the purpose and importance of earthen embankments.	Analyzing (K4)
CO5	integrate flood hazard analysis with land-use planning, early warning system	Understanding (K2)

TEXT BOOKS

1. K. Subramanya., "Hydrology and Water Resources Engineering" , Tata McGraw-Hill Education,2012.
2. G.L. Asawa., "Irrigation and Water Resources Engineering", New Age International, India, 2006.

REFERENCES

1. Ven Te Chow, David R. Maidment, Larry W. Mays., "Applied Hydrology", McGraw-Hill.,2018.
2. Zoran Vojinovic & Michael B. Abbott "Flood Risk Management", IWA Publishing,2012.
3. Larry W. Mays" Water Resources Engineering, Wiley, 2001.
4. E.M. Wilson , K. Subramanya (alternate versions) "Engineering Hydrology" Macmillan / McGraw-Hill,2013.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	-	2	1	-	-	-	-	1	-	-	2	1
CO2	1	1	-	2	1	-	-	-	-	1	-	-	1	1
CO3	2	1	-	2	1	-	-	-	-	2	-	-	1	3
CO4	2	1	-	2	1	-	-	-	-	1	-	-	1	2
CO5	2	2	-	2	2	-	-	-	-	1	-	-	2	1

AI23655	URBAN AGRICULTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	introduce urban agriculture concepts, methods, and their role in sustainable food systems.
2	explore organic and innovative farming systems suited for urban environments.
3	analyze the socio-economic, environmental, and health implications of urban farming.
4	understand urban agriculture's role in addressing hunger and supporting local economies.
5	identify urban farming challenges and propose planning, advocacy, and policy solutions.

UNIT I	PRINCIPLES AND PRACTICES OF URBAN AGRICULTURE	9

Introduction to Urban Agriculture - Definition and significance of urban agriculture; Overview of urban farming techniques - container gardening, rooftop farming, hydroponics, and aquaponics; Crop Cultivation in Urban Environments - Selecting suitable crops for urban farming, Soil management in urban settings, Integrated pest management (IPM) strategies for urban crop production; Animal Husbandry in Urban Settings.

UNIT II	INNOVATIVE AND SUSTAINABLE URBAN FARMING	9

Sustainable Farming Practices - Organic farming principles in urban agriculture, Permaculture techniques and innovative Technologies; Vertical farming systems for space-efficient crop production, LED lighting and smart irrigation systems for resource efficiency; Case Studies of Sustainable Urban Farming Projects.

UNIT III	IMPACTS OF URBAN AGRICULTURE	9

Socio-Economic Benefits of Urban Agriculture - Improving food access and food security in urban areas, Job creation and economic opportunities; Environmental Considerations, Water conservation and efficient resource utilization; Biodiversity preservation and green infrastructure; Health Implications - Access to fresh, nutritious produce, Food safety considerations in urban farming practices.

UNIT IV	FOOD SECURITY AND URBAN AGRICULTURE	9

Contribution of urban agriculture to local food production, addressing food deserts and improving food access in urban areas; Economic Contributions - Supporting local economies through urban farming initiatives, Entrepreneurial opportunities in urban agriculture; Social cohesion, Enhancing urban aesthetics and livability through green spaces.

UNIT V	CHALLENGES IN URBAN AGRICULTURE	9

Land availability and access issues - Regulatory hurdles and zoning regulations; Strategies for Promoting Urban Agriculture - Advocacy and policy development at local and regional levels, Community engagement and partnership building; Action Planning for Urban Agriculture Initiatives - Developing implementation plans for urban farming projects, Identifying resources and support networks for urban agriculture development.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe the principles and practices of urban agriculture including cropping and animal husbandry.	Understanding (K2)
CO2	apply sustainable and tech-driven methods for space-efficient urban farming.	Applying (K3)

n agriculture.	Analyzing (K4)
ınd community	Analyzing (K4)
menting urban	Applying (K3)

ıanagement", Department of Agriculture, Cooperation of farmers welfare, w Delhi, 2020.

Tanwar, Akath Singh, "Drought Mitigation and Management", Scientific

ındapaka, "Urban Farming: An

Research Needs", Water Resources Publications, Colorado State University,

griculture: Policy, Law, Strategy,

rill, Geoff Cockfield., "Drought, Risk Management, and Policy: Decision-y", Drought and Water crises, CRC press, 2013.

agement Authority, Government of India, "National Disaster Management t of Drought, 2010.

New Delhi, 2022.

ıught Assessment, Management, and Planning: Theory and Case Studies", Kluwer 93.

ır Roof into a Vegetable Garden or

ls and Techniques for the Home and

Cities", New Society Pub, 2011.

Outcome (CO's) with Programme Outcomes (PO's) and Programme

's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

PO's										PSO's	
3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	1	2	-	-	-	-	2	3	2
2	1	1	1	2	-	-	1	-	2	3	3
3	3	3	1	2	-	-	-	-	2	3	3
2	2	2	1	2	-	-	2	-	3	2	3
3	2	3	1	2	-	-	2	-	3	3	3

s (PO's) and Programme

Strong, 2-Medium, 1-Weak

			PSO's	
10	11	12	1	2
-	-	2	2	2
-	-	2	2	3
-	-	2	3	2
-	-	3	2	2
-	-	3	2	2

PAAVAI ENGINEERING COLLEGE (Autonomous)
Approved
BOARD OF STUDIES
Agricultural Engineering
26/6/25
Namakkal - 637 018.

AI23657	DIGITAL AGRICULTURAL MARKETING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	identify the different types and models of e-markets
2	learn the historical development and phases of e-market and e- commerce evolution.
3	understand the basic components and workflow of an e-commerce system.
4	analyze emerging technologies such as AI, block chain, and IoT in shaping the future of e-markets.
5	improve the structure, benefits, and challenges of the e-NAM platform as a digital agri-market model.

UNIT I	FUNDAMENTALS OF DIGITAL AGRICULTURE	9

Basics of Agricultural Marketing- Planning , production, growing and harvesting, grading, packing, transport, storage, agro-and food processing, distribution, advertising and sale; Digital Infrastructure Development; Mobile Applications for Agricultural marketing; Digital Financial Service and Payments; Digital Literacy and Farmer Empowerment.

UNIT II	E-MARKETS IN AGRICULTURE	9

E- Markets -Introduction to e- Markets, Evolution of e-Markets, E-Commerce and functioning of e-Markets, Future of e-Markets, e-Markets for Agricultural products in India, Guidelines for effective implementation of e-commerce in India; Important decisions for ecommerce, Advantages of e-Markets, Disadvantages e-markets, Case Study on e-NAM.

UNIT III	E-COMMERCE IN AGRIBUSINESS	9

Functioning of e-Commerce in Agribusiness - Online transactions, Marketing, Building trust through branding, Online promotion on the website, Customer service and value addition through e-CRM and e-SRM.

UNIT IV	DIGITAL MARKETING IN AGRIBUSINESS	9

Scope of Digital Marketing in Agribusiness - Role of internet, social media & mobile phones in marketing of agricultural products, Advantages of implementing digital marketing in Agribusiness, Disintermediation of the middle man, Growth and transfer of knowledge, Ability to connect to a wider audience, Business Open 24/7, Low cost, No wastage of Agricultural Products, Digital Marketing Techniques- Basics of Web Design & Development, Basics of Mobile App Development, Basics of Social Media marketing, Basics of Content Marketing.

UNIT V	E-NAM (NATIONAL AGRICULTURE MARKET)	9

Introduction to e-NAM- needs, objectives, vision "One Nation, One Market";structure of e-NAM- Stakeholders: Farmers, traders, APMCs, FPOs, technological backbone and mobile platform, Role of assaying, grading, and quality certification; implementation Mechanism. integration of APMCs across states, online bidding, price discovery, and fund transfer, role of the Small Farmers' Agribusiness Consortium (SFAC); benefits of e-NAM, challenges in Implementation, Impact and Future Prospects.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the concept, significance, and types of e-markets in the digital economy.	Understanding (K2)
CO2	evaluate the historical evolution and key drivers behind the growth of e-markets and e-commerce.	Applying (K3)
CO3	classify the structure, components, and functioning of e-commerce platforms.	Understanding (K2)
CO4	categorize emerging technologies and future trends in e-markets.	Analyzing (K4)
CO5	examine the implementation, benefits, and limitations of e-NAM as a model agri e-market platform.	Analyzing (K4)

TEXTBOOKS

1. Alpaydin E. 2016. "Machine learning" : the new AI. The MIT Press: Cambridge, Massachusett.
2. Uddin MS, Bansal JC. 2021. "Computer Vision and Machine Learning in Agriculture'. Springer Singapore Pte. Limited: Singapore.

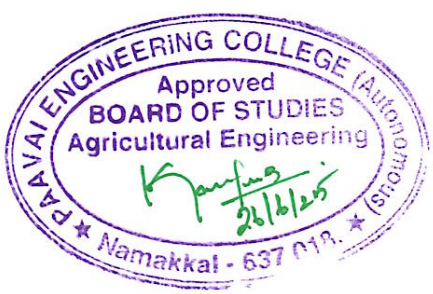
REFERENCES

1. Liakos KG, Busato P, Moshou D, Pearson S, Bochtis D. 2018." Machine Learning in Agriculture". A Review. Sensors 2018, Vol. 18, Page 2674 18: 2674. DOI: 10.3390/S18082674.
2. Zhou Z-H. 2021. "Machine Learning. Springer Singapore". DOI: 10.1007/978-981-15- 1967-3.

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	3	1	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	2	1	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	2	1	-	-
CO5	-	-	-	-	3	1	2	2	-	-	2	-	-	-



AI23851	FUNDAMENTALS OF HORTICULTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the scope, significance, and contributions of horticulture at the state, national, and global levels.
2	classify horticultural crops and identify agro-climatic zones suitable for their production.
3	analyze soil and climatic factors affecting the growth and yield of horticultural crops.
4	explain the systems of gardening and evaluate the role of protected and precision horticulture in enhancing productivity.
5	explore modern horticultural techniques such as hydroponics, vertical farming, and horticultural therapy for sustainable and therapeutic practices.

UNIT I	SCOPE AND IMPORTANCE OF HORTICULTURE	9

Area and production of horticultural crops – trends and data-based insights; Import and export potential – role of horticultural produce in foreign trade;Nutritive value of horticultural crops – vitamins, minerals, and health contributions; Medicinal value – significance in Ayurvedic and modern medicinal systems; National and regional agencies involved in promotion – including NHB, APEDA, Commodity Boards; Government schemes – mission-mode projects and subsidies supporting horticulture.

UNIT II	CLASSIFICATION AND ZONATION OF HORTICULTURAL CROPS	9

Crop based on taxonomy, usage, lifecycle, and season; Horticultural zones – agro-climatic zones of Tamil Nadu and India relevant to horticulture; Factors limiting horticultural production – such as biotic, abiotic, technological and market factors; Role of season – influence on sowing, growth, flowering, and harvesting periods; Soil and climate requirements – ideal combinations for major horticultural crops.

UNIT III	SOIL AND CLIMATIC FACTORS INFLUENCING HORTICULTURE	9

Soil – texture, structure, porosity, and water-holding capacity; Chemical properties of soil – pH, nutrient status, salinity, and organic matter; Climatic factors influencing crop growth – including light, temperature, photoperiod, and humidity; Rainfall and altitude – impact on crop selection and yield; Microclimate – localized climatic influence on horticultural production and quality.

UNIT IV	TYPES AND SYSTEMS OF GARDENING	9

Kitchen gardening – small-scale home-based food production for family use; Nutrition gardening – focused on growing diverse crops to meet dietary needs; Truck gardening – large-scale cultivation aimed at distant markets; Market gardening – intensive production near urban centers for quick market access; Vegetable forcing – cultivation of crops out of season using artificial means; Protected horticulture – use of greenhouses, polyhouses, and shade nets; Precision horticulture – application of modern tools like GIS, drones, and sensors.

UNIT V	MODERN AND THERAPEUTIC APPROACHES IN HORTICULTURE	9

Hydroponics – soil-less plant cultivation using nutrient solutions; Aeroponics – plant roots suspended in air and misted with nutrients; Nutrient Film Technique (NFT) – continuous flow of nutrients over plant roots; Vertical farming – multilayer growing systems in limited space; Horticulture therapy – use of gardening and plants for Therapeutic and Rehabilitative purposes.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe and classify different cropping systems and explain their principles and resource requirements.	Understanding (K2)
CO2	evaluate the productivity, land use efficiency, and sustainability of various cropping systems using standard indices.	Understanding (K2)
CO3	illustrate different types of farming systems and demonstrate the integration of crop and enterprise components.	Applying (K3)
CO4	analyze resource recycling methods and sustainability indicators in integrated farming systems.	Analyzing (K4)
CO5	apply cost-effective, low-input strategies and labor management practices suitable for diverse agro-ecosystems under resource constraints.	Applying (K3)

TEXT BOOKS

1. Palaniappan, S. P., & Sivaraman, K."Cropping Systems in the Tropics: Principles and Management" New Delhi: New Age International Publishers,2006.
2. Reddy, S. R. A" Textbook of Farming Systems and Sustainable Agriculture 2nd ed". New Delhi: Kalyani Publishers,2016.

REFERENCES

1. Behera, U. K., & France, J." Integrated Farming Systems for Sustainable Agriculture''. New Delhi: Narendra Publishing House. 2016.
2. Singh, S. S. "Cropping Systems: Theory and Practice." New Delhi: CBS Publishers and Distributors Pvt. Ltd. 2019.
3. Radha, T." Sustainable Agriculture and Farming Systems". New Delhi: ICAR – Directorate of Knowledge Management in Agriculture,2012.
4. Jayanthi, C. "Integrated Farming System 1st ed." New Delhi: Satish Serial Publishing House, 2011.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	2	1	2	-	-	-	-	2	1	1
CO2	3	2	3	2	2	2	3	-	-	-	-	3	1	2
CO3	2	3	3	3	3	3	2	-	-	-	-	3	2	2
CO4	3	3	2	3	2	2	2	-	-	-	-	2	1	2
CO5	3	3	3	2	3	3	3	-	-	-	-	3	2	2

AI23852	FARMING SYSTEM AND SUSTAINABLE AGRICULTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the fundamental concepts, principles, and classifications of cropping systems with emphasis on their management and resource utilization.
2	evaluate the efficiency and sustainability of different cropping systems using appropriate indices and economic parameters.
3	acquire knowledge about farming systems, including enterprise selection, integration, and the design of integrated farming models for different agro-ecosystems.
4	analyze resource recycling, sustainability, and conservation principles within integrated farming systems.
5	apply appropriate strategies for resource and labor management under constraints, while ensuring environmental sustainability and cost-effectiveness in farming systems.

UNIT I	CROPPING SYSTEM	9

Cropping systems - Definition, Principles, Concepts, Classification, mono cropping; intensive cropping; cropping systems of India and Tamil Nadu; Interaction between different cropping systems - Cropping system management; Resource management - land, nutrient, water and weed.

UNIT II	EVALUATION OF CROPPING SYSTEM	9

Index for evaluation – cropping intensity, land equivalent ratio (LER), relative yield total (RYT), competition index, and aggressivity index; Land use efficiency – assessing land utilization across seasons; Yield advantages – evaluating biological efficiency and productivity gains from inter/multiple cropping; Economic evaluation – cost-benefit analysis, profitability, income per unit area and time; Sustainability – identifying indicators for long-term viability and environmental balance in cropping systems.

UNIT III	FARMING SYSTEM	9

Farming systems – definition, scope, and integrated view of farming components;Principles and concepts– holistic resource use, diversification, and resilience; Enterprises selection – choosing compatible and profitable components - Enterprise management – resource allocation and synergy between units; Interaction between enterprises and cropping – nutrient cycling, labor sharing, and residue utilization; Integrated Farming System (IFS) - Farming system models; designing IFS models for wetland, dryland, hilly, and coastal ecosystems.

UNIT IV	EVALUATION OF FARMING SYSTEM	9

Resource recycling in IFS – reuse of farm residues, composting, integrated nutrient management; Evaluation indicators – sustainability index, nutrient balance, energy flow, and economic efficiency; LEISA (Low External Input Sustainable Agriculture); HEIA (High External Input Agriculture) – characteristics, productivity orientation, and sustainability concerns; Conservation agriculture - Concept and scope – conservation-oriented practices for enhancing soil health and climate resilience.

UNIT V	RESOURCE AND LABOUR MANAGEMENT IN FARMING SYSTEM	9

Resource management in constrained situations – optimization under limited land, water, and capital conditions; Cost reduction strategies – using efficient, economical practices and minimizing waste; Non-monetary inputs – local knowledge, organic manures, and on-farm resources; Labour management – labor planning, seasonal workload distribution, gender roles, and scope of mechanization; Farming system and the environment - Sustainable farming systems – balancing economic gains with environmental stewardship and social equity.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe and classify different cropping systems and explain their principles and resource requirements.	Understanding (K2)
CO2	evaluate the productivity, land use efficiency, and sustainability of various cropping systems using standard indices.	Understanding (K2)
CO3	illustrate different types of farming systems and demonstrate the integration of crop and enterprise components.	Applying (K3)
CO4	analyze resource recycling methods and sustainability indicators in integrated farming systems.	Analyzing (K4)
CO5	apply cost-effective, low-input strategies and labor management practices suitable for diverse agro-ecosystems under resource constraints.	Applying (K3)

TEXT BOOKS

1. Palaniappan, S. P., & Sivaraman, K."Cropping Systems in the Tropics: Principles and Management" New Delhi: New Age International Publishers,2006.
2. Reddy, S. R. A" Textbook of Farming Systems and Sustainable Agriculture 2nd ed". New Delhi: Kalyani Publishers,2016.

REFERENCES

1. Behera, U. K., & France, J." Integrated Farming Systems for Sustainable Agriculture''. New Delhi: Narendra Publishing House. 2016.
2. Singh, S. S. "Cropping Systems: Theory and Practice." New Delhi: CBS Publishers and Distributors Pvt. Ltd. 2019.
3. Radha, T." Sustainable Agriculture and Farming Systems". New Delhi: ICAR – Directorate of Knowledge Management in Agriculture,2012.
4. Jayanthi, C. "Integrated Farming System 1st ed." New Delhi: Satish Serial Publishing House, 2011.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	2	1	2	-	-	-	-	2	1	1
CO2	3	2	3	2	2	2	3	-	-	-	-	3	1	2
CO3	2	3	3	3	3	3	2	-	-	-	-	3	2	2
CO4	3	3	2	3	2	2	2	-	-	-	-	2	1	2
CO5	3	3	3	2	3	3	3	-	-	-	-	3	2	2

AI23853	LANDSCAPING AND ORNAMENTAL GARDENING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the principles and styles of landscape design and various traditional and modern garden types.
2	explain the design and planning of landscaping for various urban and institutional settings.
3	describe plant components used in landscaping and learn the production techniques of selected ornamental plants.
4	explore different types of specialized gardens and develop knowledge for establishing and maintaining lawns.
5	examine bio-aesthetic planning, eco-tourism development, and modern trends in landscaping such as xeriscaping and therapeutic gardening.

UNIT I	LANDSCAPE DESIGNS AND GARDEN STYLES	9

Landscape designs – principles of landscape architecture, use of space, symmetry, balance, scale, rhythm, and focal points. - Types of gardens – historical and cultural significance of English gardens; Mughal gardens with water channels, symmetry, and charbagh layout; Japanese gardens emphasizing minimalism and Zen aesthetics; Persian gardens with geometric layout and enclosed spaces; Spanish gardens and shaded courtyards; Italian gardens showcasing terraces, sculptures, and fountains; Traditional Indian gardens – Vanams (sacred groves), Buddha gardens - Styles of gardens – formal gardens, informal gardens with natural flow and curves.

UNIT II	URBAN LANDSCAPING AND SITE-SPECIFIC DESIGN	9

role and importance of greenery in urban spaces for environmental balance, aesthetics, and well-being; Landscaping for specific situations – institutional landscaping; industrial landscaping for pollution control and employee wellness; residential landscaping. - Hospital landscaping – healing gardens; Landscaping along roadsides and traffic islands – use of hardy; Dam site landscaping – erosion control and aesthetic integration; Landscaping for IT parks and corporate campuses – modern themes.

UNIT III	GARDEN COMPONENTS AND ORNAMENTAL PLANT PRODUCTION	9

Plant components of gardens – importance of plant diversity in garden aesthetics and function. - Arboretum – collection of trees for display and study; Shrubbery - Fernery and palmatum – Edges and hedges – boundary definition and ornamental division; Climbers and creepers – vertical accentuation and wall coverage - Cacti and succulents – drought-tolerant and decorative plants; Herbs and annuals – seasonal color and scent; Flower borders and beds – structured planting - Ground covers and carpet beds – soil protection; Bamboo groves – screening and landscape accent; Production technology – nursery practices - ornamental plants.

UNIT IV	LAWNS AND SPECIAL GARDEN TYPES	9

Lawns – selection of grass species, methods of establishment, soil preparation, seeding, turfing, and sodding; Maintenance – mowing, irrigation, fertilization, aeration, pest and weed control; Sunken gardens offering sheltered green zones; rock gardens emphasizing drought-tolerant plants and rock arrangements; Clock gardens and color wheels – thematic design; Temple gardens and sacred groves – religious and cultural plantings integrating native,sacred species and traditional beliefs.

UNIT V	ADVANCED LANDSCAPE CONCEPTS AND COMPONENTS	9

Bio-aesthetic planning – integration of functional and aesthetic values in urban and rural planning; Eco-tourism – landscape development for nature-based tourism, interpretative trails, and biodiversity conservation; Theme parks –

Indoor gardening – houseplants, container gardening, green interiors, and maintenance practices; Therapeutic gardening- Non-plant components – benches, sculptures, lights, pathways, and signage for enhancing usability and appeal; Water scaping – ponds, fountains, waterfalls, and aquatic plants; Xeriscaping – landscaping for water conservation; Hardscaping – patios, decks, walls, and pavements integrated into garden layouts.
TOTAL PERIODS : 45

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	describe various landscape design principles and differentiate between Indian and international garden styles.	Understanding (K2)
CO2	explain the landscape designs for urban and special-purpose sites such as institutions, industries, and roadsides.	Understanding (K2)
CO3	apply key plant components used in gardens and explain their functional and aesthetic roles, including basic production methods.	Applying (K3)
CO4	develop and manage lawns and specialized gardens like vertical, roof, and rock gardens.	Applying (K3)
CO5	analyze the role of landscape gardening in sustainable development, including bio-aesthetic planning, indoor and therapeutic gardening and landscape techniques.	Analyzing(K4)

TEXT BOOKS

1. Bose, T. K., Maiti, R. G., Dhua, R. S., & Das, P. "Floriculture and Landscaping 2nd ed.". Kolkata: Naya Udyog. 2003.
2. Randhawa, G. S., & Mukhopadhyay, A. |"Floriculture in India". New Delhi: Allied Publishers,1986.

REFERENCES

1. Adams, D., & Stoecklein, M. "Landscape Design: A Cultural and Architectural History" New York: Harry N. Abrams,2011.
2. Bhattacharjee, S. K "Landscape Gardening and Design". New Delhi: Aavishkar Publishers'2006.
3. Tiwari, A. K "Handbook of Landscaping and Garden Designs"New Delhi: Gene-Tech Books,2014
4. Sharma, R.R "Ornamental Horticulture and Landscaping" New Delhi: International Book Distributing Co.2014.

CO-PO MAPPING:

Mapping of course outcome(CO'S) with programme outcomes (PO'S) and programme specific Outcomes (PSO'S) (1/2/3 indicates strength of correlation) 3-strong, 2-Medium, 1-Weak

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	-	1	2	3	-	-	-	-	2	1	1
CO2	2	-	-	-	1	1	2	-	-	-	-	1	1	1
CO3	3	3	2	3	1	3	3	-	-	-	-	3	-	-
CO4	3	3	2	3	2	3	2	-	-	-	-	3	1	-
CO5	3	3	3	2	3	3	3	-	-	-	-	2	-	1

AI23854	ENVIRONMENTAL SOIL PHYSICS	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the physical properties and processes of soil relevant to environmental and agricultural applications.
2	analyze the behavior and movement of water, gas, and solutes in soil systems.
3	apply physical principles to assess soil quality, water retention, and plant-water interactions.
4	analyze the environmental issues related to soil physics such as erosion, salinization, and pollution.
5	develop foundational knowledge for advanced topics in soil science, environmental engineering and precision agriculture.

UNIT I	SOIL PHYSICAL PROPERTIES AND FUNDAMENTALS	9

Soil physical properties and classification –understanding the three-phase system of soil (solid, liquid, gas), volume-mass relationships, porosity, bulk density, and textural classifications; Emphasis on soil profile development and diagnostic horizons influencing plant growth; Chemical and biological properties of soil – soil pH, cation exchange capacity (CEC), salinity, organic matter, microbial activity, and their role in nutrient cycling.

UNIT II	SOLID PHASE OF SOIL	9

Water in soil – retention and movement – study of soil moisture potential, field capacity,wilting point and Hydraulic conductivity – Analysis of water flow in saturated and unsaturated soils and factors influencing infiltration, percolation, and redistribution.

UNIT III	LIQUID PHASE AND WATER MOVEMENT	9

Soil water potential components- matric, osmotic, pressure, and gravitational – Soil moisture characteristic curve and hysteresis – Infiltration, percolation, and water movement under saturated and unsaturated conditions – Water retention, field capacity, permanent wilting point, and available water – Relevance of water movement in irrigation planning, drainage design and plant–water relationships for sustainable environmental management.

UNIT IV	SOIL AERATION, GAS EXCHANGE, AND THERMAL PROPERTIES	9

Soil air and thermal regimes – gaseous composition of soil, gas exchange mechanisms, and aeration status – Heat transfer in soil, thermal conductivity, specific heat, and impact on plant development and microbial activity - Agronomic practices for optimizing soil aeration and temperature - Role of soil organic matter and structure in modifying gas and heat flow; Case studies on mitigating thermal and aeration stress in field conditions.

UNIT V	SOIL AND WATER PHASE RELATIONSHIPS	9

Soil water and its forms – classification of soil water (gravitational, capillary, and hygroscopic); Soil moisture tension and water potential components; Continuity equation in a three-phase medium and its environmental relevance. Infiltration, percolation, and hydraulic conductivity – factors influencing water movement in soil and application of Darcy's Law – Soil–water characteristic curves and hysteresis. Measurement of soil moisture – gravimetric, tensiometric, and modern sensor-based techniques.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	identify and describe physical characteristics of soils and their environmental significance.	Understanding (K2)
CO2	measure and interpret soil water, air, and temperature properties using standard methods.	Understanding (K2)
CO3	model the movement of water and solutes in soil under various field conditions.	Applying (K3)
CO4	analyze soil physical constraints affecting plant growth, erosion, and water management.	Analyzing(K4)
CO5	identify and describe physical characteristics of soils and their environmental significance.	Applying (K3)

TEXT BOOKS

1. Hillel, Daniel (2004) "Introduction to Environmental Soil Physics"Academic Press, Elsevier.
2. Brady, Nyle C. and Weil, Raymond R "The Nature and Properties of Soils" (15th Edition),Pearson Education.

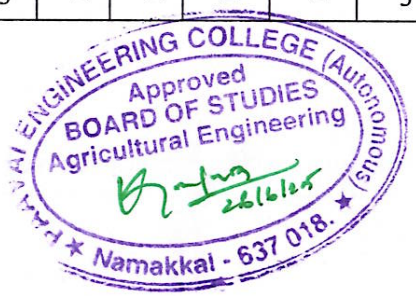
REFERENCES

1. Lal, R., & Shukla, M.K. "Principles of Soil Physics" Marcel Dekker (CRC Press) 2004
2. Jury, W.A., & Horton, R "Soil Physics",6th Edition ,John Wiley & Sons.2004
3. Black, C.A. (Ed.) "Methods of Soil Analysis: Part 1 - Physical and Mineralogical Properties" American Society of Agronomy, Madison, WI.1965
4. Marshall, T.J., Holmes, J.W., and Rose, C.W "Soil Physics" (3rd Edition) Cambridge University Press 1996.

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	–	–	1	1	2	–	–	–	–	1	1	1
CO2	2	3	2	2	–	1	2	–	–	–	–	2	1	1
CO3	3	2	3	3	2	3	2	–	–	–	–	3	2	1
CO4	2	3	3	3	2	2	2	–	–	–	–	2	1	2
CO5	3	3	3	2	3	3	3	–	–	–	–	3	1	2



AI23855	POULTRY FARM MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart knowledge on different breeds and types of poultry used for commercial and backyard farming.
2	familiarize students with scientific poultry housing, feeding, breeding, and management practices.
3	develop skills for disease prevention, health care, and hygiene in poultry farming.
4	understand the economics of poultry farming including budgeting, marketing, and entrepreneurship.
5	apply sustainable and welfare-oriented poultry production systems.

UNIT I	INTRODUCTION TO POULTRY SCIENCE AND INDUSTRY	9

Importance of poultry farming in India and globally – History and development of the poultry sector – Classification of poultry: layers, broilers, native birds, ducks, quails, turkeys – Characteristics of breeds and strains – Comparison of backyard and commercial systems – Poultry production and consumption trends – Economic contribution to rural livelihoods.

UNIT II	POULTRY HOUSING AND ENVIRONMENTAL MANAGEMENT	9

Site selection for poultry farms – Types of housing systems: deep litter, cage, semi-intensive, free-range – Design and orientation of poultry houses – Ventilation, insulation, lighting, and temperature control – Litter materials and management – Environmental control measures – Biosecurity protocols and sanitation.

UNIT III	POULTRY FEEDING AND NUTRITION	9

Nutrient requirements for chicks, growers, layers, broilers, and breeders – Classification and function of nutrients – Common feed ingredients and feed formulation – Feeding systems: mash, pellets, crumbles – Feed storage and quality control – Use of feed additives - probiotics, prebiotics, enzymes, herbal supplements.

UNIT IV	POULTRY BREEDING, HATCHERY MANAGEMENT, AND HEALTH CARE	9

Reproductive physiology of poultry – Selection and breeding methods – Artificial incubation and hatchery hygiene – Candling, chick grading, and sexing – Vaccination at hatch – Common poultry diseases: viral, bacterial, parasitic – Vaccination schedules – Health monitoring and record keeping – Biosecurity in disease prevention.

UNIT V	POULTRY ECONOMICS, MARKETING, AND SUSTAINABILITY	9

Economic planning and budgeting – Cost of production and profitability – Preparation of project reports – Marketing channels for eggs, meat, and value-added products – Cold chain and transportation – Waste management – Animal welfare and environmental sustainability – Government schemes and policies for poultry development.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the breeds, production systems, and importance of poultry farming.	Understanding(K2)
CO2	apply scientific housing, feeding, and breeding practices for efficient farming.	Applying (K3)

CO3	analyze economic feasibility and cost-benefit of poultry enterprises.	Analyzing(K4)
CO4	manage health, disease prevention, and sanitation in poultry farms.	Analyzing (K4)
CO5	demonstrate skills for sustainable, profitable, and welfare-oriented farm setup.	Applying (K3)

TEXT BOOKS

1. Singh, R.A- "Poultry Production" Kalyani Publishers, New Delhi.2005
2. Niranjan, M., & Rajkumar, U. "Scientific Poultry Farming" New India Publishing Agency, New Delhi.2016

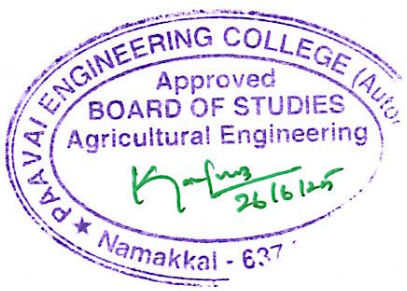
REFERENCES

1. Banerjee, G.C. "A Textbook of Animal Husbandry" (8th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.2019.
2. Scanes, C.G " Poultry Science" Waveland Press, USA.2010
3. Raman, K.V "Principles of Poultry Production" ScienceTech Publications, India.2008
4. Bell, D.D., & Weaver, W.D. "Commercial Chicken Production" Manual 5th Edition, Springer.2002

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	–	2	1	2	–	–	–	–	1	3	2
CO2	3	3	2	2	2	2	3	–	–	–	–	2	3	3
CO3	2	2	3	3	3	3	2	–	–	–	–	2	2	3
CO4	2	2	2	2	3	3	3	2	–	–	–	3	2	2
CO5	3	3	3	2	2	2	3	2	2	2	1	3	3	3



AI23856	FUNDAMENTALS OF AQUACULTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand about aquaculture systems, species, and practices.
2	explain the biological, environmental, and technical aspects of aquatic organism farming.
3	understand seed production, water quality, feeding, and health management in aquaculture.
4	apply economics, sustainability, and national programs in aquaculture development.
5	apply entrepreneurship in aquaculture and allied sectors.

UNIT I **INTRODUCTION TO AQUACULTURE** **9**

Definition and concept of aquaculture and its distinction from capture fisheries and traditional fishing practices ; History, scope, and significance of aquaculture in India and the world; Role of aquaculture in food security, livelihood generation, and rural development; Types of aquaculture based on water salinity- freshwater, brackish water, and marine aquaculture; Overview of current status, trends, and future prospects of aquaculture in India and globally.

UNIT II **AQUATIC ENVIRONMENT AND WATER QUALITY** **9**

Basic understanding of the aquatic environment essential for aquaculture; Key physical, chemical, and biological parameters affecting aquaculture productivity including temperature, pH, dissolved oxygen, ammonia, and turbidity; Water quality management practices for sustainable fish growth and survival; Problems like oxygen depletion, algal blooms, and ammonia toxicity – their causes and management; Importance of soil characteristics in pond-based aquaculture and soil-water interaction.

UNIT III **AQUACULTURE SYSTEMS AND INFRASTRUCTURE** **9**

Classification of aquaculture systems: extensive, semi-intensive, and intensive systems and their suitability – Different culture units - earthen ponds, cement tanks, raceways, cages, pens, biofloc systems, and recirculatory aquaculture systems (RAS); Criteria for site selection including topography, water availability, and soil suitability; Layout and design of fish farms with emphasis on pond construction, liming, fertilization, and water control structures; Preparation and management of ponds prior to stocking.

UNIT IV **AQUATIC ORGANISMS AND SEED PRODUCTION** **9**

Overview of important cultivable species: Indian major carps, catfishes, tilapia, freshwater prawns, brackishwater shrimps, molluscs, and seaweeds. – Introduction to seed production units such as hatcheries and nurseries. – Breeding methods including natural and induced breeding, bundh breeding, and hormonal induction. – Hatchery operations: collection, fertilization, incubation, larval rearing, and fry management. – Transportation of fish seed and best practices for handling and stocking.

UNIT V **NUTRITION, HEALTH, AND ECONOMICS OF AQUACULTURE** **9**

Basics of fish nutrition and classification of feeds: natural feed, supplementary feed, and formulated feed; Feed ingredients, feed formulation techniques, feeding methods, and feed storage; Common fish and shrimp diseases: bacterial, viral, fungal, and parasitic infections – symptoms, causes, and preventive measures; Biosecurity and health management practices in aquaculture; Economic evaluation of aquaculture farms including cost estimation,

input-output budgeting, and profitability analysis; Overview of national and international organizations in aquaculture development such as NFDB, MPEDA, ICAR-CIFA, and FAO.	
	TOTAL PERIODS: 45

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	explain the scope and significance of aquaculture and identify major production systems.	Understanding (K2)
CO2	analyze water quality parameters and their influence on aquatic organism health.	Analyzing (K4)
CO3	demonstrate understanding of culture system design, site selection, and farm setup.	Applying (K3)
CO4	apply knowledge of breeding, seed production, and nursery management techniques.	Applying (K3)
CO5	analyze the aquaculture economics and demonstrate awareness of sustainable practices.	Analyzing(K4)

TEXT BOOKS

1. Jhingran, V.G. "Fish and Fisheries of India" Hindustan Publishing Corporation,1991.
2. Pillay, T.V.R "Aquaculture: Principles and Practices. Fishing News Books, UK,1993

REFERENCES

1. FAO Manuals and CIFA Publications – for applied and practical insights.
2. Boyd, C.E "Water Quality in Ponds for Aquaculture" Auburn University Press,1990
3. Santhanam, R "Aquaculture Technology and Environment" Daya Publishing House.1990

CO PO MAPPING

*** Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3/Indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

COs	PO'S												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	–	1	2	3	–	–	–	–	2	1	1
CO2	2	–	–	–	1	1	2	–	–	–	–	1	1	1
CO3	3	3	2	3	1	3	3	–	–	–	–	3	–	–
CO4	3	3	2	3	2	3	2	–	–	–	–	3	1	–
CO5	3	3	3	2	3	3	3	–	–	–	–	2	–